Intensive Materialism
Matter, minds and bodies in Victorian science and literature

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Intensive Materialism: matter, minds and bodies in Victorian science and literature

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DECLARATION

I declare that this work contains no material previously published or written by another person except where due reference has been made in the text.

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ABSTRACT

In nineteenth-century Britain, Victorians began to make strange new discoveries about matter. As it was cracked open and broken into smaller pieces, scientists found a world previously hidden from view: a world populated by interconnected 'fields', atomic vortices, fluctuating energy and organic morphogenesis. The more these bizarre phenomena were scrutinised, the more they resisted quantification. Saddled with explanatory paradigms unable to describe this new 'intensive' realm, scientists and writers delved deep into the imagination, experimented with their bodies and pushed language to its conceptual limits. Peering beyond sense and logic, they realised that neat distinctions between mind and matter, order and chaos, the reasonable and the absurd, were no longer viable. This world of recalcitrant matter and energy could not simply be uncovered—it had to be made too.

As matter, minds and bodies intermeshed in dynamic, sometimes frightening ways, the very foundations of thought began to shift. This thesis focuses on a number of literary and scientific texts that responded to and participated in the creation of this nineteenth-century turn to intensive materialism. Reading texts by authors and scientists such as John Tyndall, Robert Browning, Henry James, P. G. Tait, Frederic Harrison and James Clerk Maxwell, it argues that writing began to function autonomously and elusively. Sometimes it generated unexpected information in excess of its constituent terms; other times it exposed unresolvable ontological tensions. Offering a new way to think about materialism, this thesis considers bodily, mental and literary thought as partially morphogenetic and nonhuman. By analysing texts and their wider cultural reception, it suggests that we can trace the interrelated turns that created Victorian Britain's intensive worldview.

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INTRODUCTION

Intensive materialism in Victorian Britain

A tiny man alone in a wilderness of white running and running. Or, perhaps not—perhaps he is dancing. No matter, what is important is that the man is *moving*. His motion is continuous yet rhythmic and predictable, each step part of a simple pattern. I know the man's precise movements because I have complete control over him: when he moves, how he moves, the speed at which he moves. I know because I made him.

We started with a strip of paper. On it I drew a dozen versions of the man each slightly different from the one before. My dad, an engineer by trade, took on the more difficult task of putting together the moving components of the zoetrope. He attached the reel of paper to the circumference of an old CD and enveloped it with a cylinder of dark cardboard, punctured by carefully spaced viewing slits. After some trial and error, he mounted this makeshift drum to a Lego base with a working gear mechanism and crank. I cannot remember any more of the mechanical details of our homemade zoetrope or the exact scene it depicted. What I do recall with absolute clarity is the feeling it inspired. Our version of this popular Victorian toy was made uniquely ours through a combination of my passable drawing skills and my dad's superior engineering ability.[1] It gave him a chance to explain how a series of static drawings could transform into a continuous moving image. But what really captivated me that afternoon was my dad's suggestion that our zoetrope was a very basic type of film projector. This enthralled me. Using no more than household bits and bobs we had made our own personal cinema. We had made inert stuff come alive.

[1] The British mathematician William George Horner invented the first iteration of the zoetrope in 1834. The device did not become a mass produced household object, however, until slight modifications to its design were made in the 1860s and were patented in America and England.

It was only much later that I realised the extent to which our homemade zoetrope had gripped my imagination. Its union of art, science and modelling; the haptic and practical knowledge derived from its construction; its indistinct boundaries separating discrete components from functioning machine, passive viewer from active participant; its function as both an object under my control *and* an object with the capacity to induce a visual illusion in my mind—all these ideas would influence my thoughts and later, my academic interests. Of course, the etymological origin of 'zoetrope' also hints at these ideas. A compound of the Greek roots ζωή *zoe*, 'life', and τρόπος *tropos*, 'turning' (derived from the verb τρέπειν *trepein*, 'to turn, to alter, to change') the word roughly translates as 'wheel of life' or 'life turner'.[2] The elegance of the term describes the operation of the machine while also hinting at the ephemeral quality of its images. Together these aspects expose a curious contradiction. The image reel's visibility and interchangeability undercuts the illusory nature of the zoetrope's phantasmagoric conjuring act. The brain can be tricked—but you can see how it is being tricked. And yet, try as you might to resist the illusion, it is impossible not to see the zoetrope's production of apparent movement. The effect is wholly determined by a dynamic intermeshing of human and nonhuman components where, for a few fleeting moments, both become involved in a 'turning' of life, in a material transformation. But there is also a sense in which the turning of the zoetrope overpowers the mind. It is not just my dad and I who had control over our moving man. Once arranged in a particular way, these apparently inert materials had a unique control over us too.

Such material transformations, and the dynamic interactions between humans and nonhumans, mind and matter, imagination and reality, are the subject of this thesis. In a general sense, this study has emerged as a way of interrogating some of the ideas I experienced that afternoon with my dad by teasing them out of their inchoate state and fixing them in language. But the zoetrope's significance here as both a tactile object and metaphorical construct is resonant because of the historical era in which it

[2] The name zoetrope was coined by William F. Lincoln, who patented the device in America.

was manufactured. More specifically, this thesis is about a material turn—or rather, turns—that gripped Victorian Britain in the latter half of the nineteenth century as matter, thought and bodies became entwined in complex new arrangements.

Spurred by new discoveries revealing a world of incorporeal matter, fluctuating energy and abyssal time, Victorians were forced to contend with a reality that was far more unruly and disturbing than had previously been imagined.[3] As geologists dug deep into the earth uncovering the fossilised remnants of ancient life forms, physicists leapt from submicroscopic realms fizzing with clashing atoms to the vast and "gloomy domains of space".[4] Biologists, meanwhile, picked apart the bodies, minds and behavioural characteristics of animals. As they did, the boundaries separating humans from supposedly baser creatures began to disintegrate. And while the combination of cutting-edge research from separate scientific domains facilitated the production of novel technological innovations, engineers, like those who worked tirelessly laying the troublesome 1858 transatlantic telegraph cable, were still vexed by anomalies that defied their plans.

In all of these encounters, Victorians were shocked by matter's recalcitrance. As it was cracked open and broken into smaller pieces, "[o]rdinary modes of measuring space and time fail[ed]".[5] Across scientific, cultural and philosophical domains, inherited explanatory paradigms and epistemological certainties began to crumble. In 1863, John Herschel, considering the incommensurability of nature, wrote:

> [W]hen we come to measure in figures either the magnitude or minuteness of its mechanisms, we find our arithmetic almost breaking down in the attempt, and numbers of ten or twenty places of figures, as it were tossed about like dust.[6]

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[3] Throughout, my use of the term 'incorporeal' follows Brian Massumi's definition. To think, he writes, "[of] the body in movement … means accepting the paradox that there is an incorporeal dimension *of the body*. Of it, but not it. Real, material, but incorporeal. Inseparable, coincident, but disjunct. … This would make the incorporeal something like a phase-shift of the body [similar to the relationship between energy and matter]." Brian Massumi, *Parables for the Virtual: Movement, Affect, Sensation* (Durham, NC: Duke University Press, 2003), p. 5.
[4] Anon., 'Comets', *The Spectator*, 47 (1874), 911-12 (p. 911).
[5] Ibid.
[6] John Herschel, 'The Sun', *Good Words*, 4 (1863), 273-84 (p. 273).

Herschel was not alone in feeling that matter resisted his attempts to quantify it. In spite of their attempts to ground knowledge in empirical evidence, the Victorians were often unable to make their ever accumulating piles of data fit within categorical frames of reference. Matter was no longer simply the brute stuff governed by deterministic forces. It pushed the "researchers of science [to] touch more nearly than ever upon the verge of that mysterious borderland which separates the seen from the unseen."[7] Even time and space, dimensions long assumed to be homogenous, continuous and isomorphic, were transformed by the development of non-Euclidean geometries. For some, such as the physicist Hermann Helmholtz, these new spatial dimensions showed time and space were not, as Kant had maintained, transcendental, necessary forms of intuition. For others, non-Euclidean spaces had metaphysical, mystical even spiritual value.

These discoveries were created as much as they were found. Divergent, imaginative and often contradictory ideas produced not just speculative fictions but also real, testable 'facts'. And as esoteric as these ideas were, they reached well beyond the confines of science and mathematics. For scientists, interacting with matter was their job. But novelists, essayists and others outside of the professional world of science were equally bound up with these new ways of thinking. Their work was also devoted to trying to make sense of, and finding truth in, a changing material world—to articulating experiences, impressions and fears that had not yet been expressed. The onset of such an entangled mass of contradictory ideas and doubts about the material world is difficult to locate with precision. A variety of turns, not all following one another in neat linear succession, contributed to this shift in the nineteenth century. But to trace the stories of Victorian 'intensive materialism', we first have to go back in time to see how and why people's relationship with matter began to change.

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[7] Anon., 'The Supernatural in Nature', *Golden Hours: Illustrated Monthly*, 12 (1879), 70-71 (p. 70).

Newtonian order

For a while, matter and mind were separate, stable entities. During the seventeenth century, natural philosophers held that with the application of reason, the material world could ultimately be known. Matter, though still mysterious, seemed to obey laws of cause and effect and could be neatly subdivided into its numerous but coherent forms. In the late 1680s, Isaac Newton built on Keplerian physics to establish rational mechanics. Newton, in the preface to his *Principia* (1687), defined this branch of analysis as "the science of motions resulting from any forces whatsoever, and of the forces required to produce any motions, accurately proposed and demonstrated".[8] This system had unrivalled explanatory power: it united terrestrial and celestial phenomena under the universal law of attraction. His contributions to the development of rational mechanics made Newton a heroic figure of the times. As Alexander Pope wrote in his famous eulogy, "Nature and Nature's laws lay hid in night; God said, Let Newton be! and all was light".[9] Pope's words are indicative of the general Enlightenment belief that reason could illuminate the obscured but ultimately immutable laws of Nature. Indeed, by the time of Newton's death in 1727, the mathematical and physical sciences had rapidly grown into the dominant forces driving the production of knowledge. Newtonian science offered a world of absolutes: solid particles of matter moving through "[a]bsolute space ... always similar and immovable", presided over by "[a]bsolute, true, and mathematical time" flowing "equably without regard to anything external".[10]

Newtonian mathematics was a powerful descriptive language. It could represent with great precision the forceful relations governing the behaviour of material bodies in space. But Newtonianism also embodied order in its analytical methods. According to

[8] Isaac Newton, *The Mathematical Principles of Natural Philosophy*, trans. Andrew Motte (New York: Daniel Adee, 1846), p. lxvii
[9] Alexander Pope, 'Intended For Sir Isaac Newton', in *The Works of Alexander Pope*, ed. William Roscoe, 10 vols, (London: C. and J. Rivington, 1824), iii, p. 378.
[10] Newton, *Principles*, p. 77

Robert Markley, seventeenth-century natural philosophers equated the "epistemological practices of experimental science" with the "authoritative word of the Bible".[11] In so doing, they created an "idealized semiotics that ordered natural phenomena by the simple act of naming them."[12] Rational mechanics served an ideological purpose. It was not simply an explanatory system but attempted to establish a correlation between the inner workings of the mind and the operations of external phenomena. If the Newtonian paradigm made certain ontological assumptions about matter, it did so partly to ground strategies of knowing within a theological framework. The mind, working in proportional harmony with the world, could unite humans and God. 'Ordering' matter had theological as well as scientific value. From the mechanical description of universal force to the moral hierarchisation of cultural practices, rational ordering constituted an expression of divine continuity. "God is the same God, always and everywhere," wrote Newton, and the "ways of mankind" operate "by a certain similitude". "[W]ithout dominion, providence, and final causes, [there] is nothing else but Fate and Nature."[13]

Newtonian regularity, material and rational, was thus extended as a general principle to the workings of the entire universe. As Markley argues, this paradigm was applied across numerous domains outside the enclosed world of natural philosophy—from the manufacturing industry to trade and navigation. Newtonianism's preoccupation with regulated continuity must therefore be seen "as an ideological structure of beliefs that integrated scientific research into the political and economic operations" of British society, often to promote "the justification of 'order' for its own sake."[14] The influence of rational mechanics was thus not limited to the scientific

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[11] Robert Markley, 'Representing Order: Natural Philosophy, Mathematics, and Theology in the Newtonian Revolution' in *Chaos and Order: Complex Dynamics in Literature and Science*, ed. N. Katherine Hayles (Chicago and London: University of Chicago Press, 1991), pp. 125-48 (pp. 127-28).
[12] Markley, 'Representing Order', p. 129.
[13] Newton, *Principles*, pp. 505-06.
[14] Markley, 'Representing Order', pp. 141-42.

sphere: its 'ordering' of matter and mind impacted social, cultural and political modes of thought too.

Pondering the imponderable

By the late eighteenth century, natural philosophers were beginning to realise things were not as simple as they seemed. Over time, the universal reach of rational mechanics had waned, and along with it, the supposition that any state of matter—past, present or future—could, theoretically, be determined with absolute certainty. Moreover, Newton's theory was marred by some fundamental problems that refused to remain buried. Matter just did not seem to be as coherent as Newton had claimed, the ontological status of force, for example, proving particularly troublesome. Newton never really explained what force actually was. He could describe in great detail the *operational effects* of force on physical bodies, but beyond that, it remained an immaterial principle. The ambiguity of force, in both its material nature and the words used to describe it, fuelled the long and bitter *vis viva* controversy—a debate in which the Cartesian notion of *vis mortura*, or dead force, was seen to contravene Leibniz's notion of *vis viva*, living force. The Dutch scientist Pieter van Musschenbroek summed up the profound confusion force engendered among natural philosophers:

> Is force then physical being? Or a unique substance? Or is it an idea first produced in the perceiving mind and thereafter imparted to bodies, among which it passes from one into another? None of these can be demonstrated, and it is better to admit our ignorance, or acknowledge that our minds are not fit to form a clear idea of this thing.[15]

Alongside the ontological uncertainty of force, light, magnetism and electricity began to be considered in terms of their imponderability. Imponderable matter differed

[15] As quoted by E. G. Ruestow, *Physics at Seventeenth and Eighteenth-Century Leiden: Philosophy and the New Science in the University* (The Hague: International Archives of the History of Ideas, 1973), p. 127.

from ordinary matter in that it had no mass and was thus imperceptible. By the latter half of the eighteenth century, the dominant view amongst natural philosophers was that these phenomena were either propagated by, or comprised of, imponderable 'fluids'. The low density and high elasticity of suprasensual 'ethereal' mediums meant their repulsively charged particles could flow around and permeate ordinary matter. Imponderable phenomena were thus conceived as having properties broadly analogous with regular fluids. For the younger John Bernoulli, the fluid ether contained "an immense number of excessively small whirlpools" whose centripetal force generated its elastic properties. For Franz Aepinus, "the permanence of magnets was accounted for by supposing the [magnetic] fluid to be entangled in their pores".[16]

Heat too was conceived as an imponderable substance with fluid-like qualities. Building on a hypothesis first proposed by Johann Becher and Georg Ernst Stahl in the late seventeenth century, eighteenth-century chemists began to associate heat with an elemental substance termed 'phlogiston'. Proponents of the theory, including the English clergyman Joseph Priestley and French chemist Claude-Louis Berthollet, claimed that combustible materials such as wood released this inflammable element when burned. The ash pile produced from combustion was simply the remnants of wood, now *dephlogisticated*. When further experiments showed that materials set alight in an enclosed space would cease to burn faster than in an open environment, Priestley claimed the "experiment ... prove[d] decisively that the principle which has hitherto been called phlogiston is a real *substance*, and even adds considerably to the *weight* of bodies [emphasis original]."[17]

Of course, what Priestly had in fact observed, was the effect of oxygen starvation: a finding proved by Antoine Lavoisier in 1873. Even before Lavoisier had picked apart the gaping holes in the phlogiston theory, he already regarded it as "a

[16] E. T. Whittaker, *A History of the Theories of Aether and Electricity* (London: Longmans, Green, and Co., 1916), p. 101; 55.

[17] Joseph Priestly, as quoted in Alan Musgrave, 'Why did oxygen supplant phlogiston? Research programmes in the Chemical Revolution' in *Method and Appraisal in the Physical Sciences*, ed. Colin Howson (Cambridge: Cambridge University Press, 1976), pp. 181-210 (p. 199).

myth, an idle mischievous theory with neither foundation nor substance."[18] However, Lavoisier, like Priestly, himself made a speculative leap into the realm of imponderable matter. In place of phlogiston, Lavoisier conceived the source of heat as deriving from another subtle element: 'caloric'. Like the vast majority of other imponderable substances, caloric was held to be weightless and to flow between the particles of common matter. Naturally, this made it invisible, its presence inferred from secondary effects. In one sense, caloric was still a vast improvement over the phlogiston theory. It conformed more readily to experimental results and, in Lavoisier's claim that the total quantity of caloric substance remained constant throughout the universe, anticipated the principle of the conservation of energy. For Bruce Clarke, the "scientific fiction" of caloric thus provided "the conceptual scaffolding for Sadi Carnot's ideal heat-engine", upon which "the successful elaboration of thermodynamic theory rested".[19] Helge S. Kragh adopts a similar view: "caloric theory was not only a cornerstone of chemistry, it also served as the foundation … of what came to be known as thermodynamics".[20] On the other hand, the caloric theory was seen as inimical to the formulation of the dynamical theory of heat. Originally writing in 1930, chemist and historian Bernard Jaffe claimed that "[i]n avoiding the pitfall of one monstrosity, Lavoisier fell into the snare of caloric, the imbecile heir of phlogiston."[21] For physicist and historian Jennifer Coppersmith, the caloric theory worked to "retard acceptance of the true dynamic theory of heat."[22] And, in the words of historian Richard Brown, "[t]he caloric theory of heat … certainly obstructed study of the theory of the steam engine."[23]

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[18] Bernard Jaffe, *Crucibles: The Story of Chemistry from Ancient Alchemy to Nuclear Fission* (New York: Dover Publications, 1976), p. 75.
[19] Bruce Clarke, *Energy Forms: Allegory and Science in the Era of Classical Thermodynamics* (Ann Arbor: University of Michigan Press, 2001), p. 165
[20] Helge S. Kragh, *Entropic Creation: Religious Contexts of Thermodynamics and Cosmology* (Aldershot: Ashgate Publishing, 2008), p. 23.
[21] Jaffe, *Crucibles*, p. 76.
[22] Jennifer Coppersmith, *Energy, the Subtle Concept: The Discovery of Feynman's Blocks from Leibniz to Einstein* (Oxford: Oxford University Press, 2015), p. 188.
[23] Richard Brown, *Society and Economy in Modern Britain 1700-1850* (London: Routledge, 1991), p. 47.

These contradictory views are instructive. Aside from showing the interpretative flexibility inherent to historiographical studies, they also draw attention to how changing conceptions of matter maintained a conflicted relationship to emergent nineteenth-century scientific paradigms. Indeed, imponderable fluid theories bridged the mechanical force hypotheses of the seventeenth century with the Victorians' development of dynamical notions of matter. Theories of subtle fluids grew out of Newton's idea proposed in *Opticks* that a force-bearing ether pervaded space. But the notion of elastic, suprasensual substances permeating space also anticipated Victorian physics' turn towards the study of transformative energetic process and undulatory propagation. Whether eighteenth-century imponderable theories had a negative or positive effect on the development of nineteenth-century conceptions of matter is a contentious issue, and one without a simple answer. What is more certain, however, is that the focus on undetectable material processes challenged purely mechanical ontologies. Matter was no longer simply brute stuff attracted, repelled and moulded by external forces. It was also invisible, indeterminate and seemed to have its own internal store of force.

Imponderable theories also destabilised epistemological schemas by exposing the problematic intersection of thought and reality. Both Priestly and Lavoisier were able to make their deductive leaps about heat partly because of the ubiquity of speculative modes of investigation. For some of Priestly and Lavoisier's contemporaries, this had disturbing implications. Lorraine Daston notes that the supposed opposition between natural 'facts' and human 'artifacts' led some eighteenth-century thinkers to regard imaginative contemplation as antithetical to reason. What "most terrified" Enlightenment naturalists such as George Cuvier were "the errors of construction, of a world not reflected in sensation but made up by the imagination."[24] Yet, the problem with this view, argues Daston, is that it did not reflect the inherently ambivalent function of the imagination in eighteenth-century thought. Divorced from

[24] Lorraine Daston, 'Fear and Loathing of the Imagination in Science', *Daedalus*, 127 (1998), 73-95 (p. 76).

all reason, imagination "could distort and obliterate facts". But the application "of healthy imagination … subject to rules", was also essential to the formulation of real physical truths.[25] Indeed, for the philosopher Wilhelm von Humboldt, "observational understanding and the poetic power of imagination … stand together in harmonic conjunction".[26] Lavoisier's caloric occupies a conceptual middle ground between these two extremes. While the theory was ultimately shown to be erroneous it nonetheless "served as a vicarious palliative", countering "the lethal dose of phlogiston" with a measure of scepticism.[27] Indeed, the caloric theory demonstrated the value of competition between ideas. More importantly, however, it showed that the imagination was a *necessary* part of science. Presented with a world of invisible matter that resisted detection, thought had to be creative in its construction of new theories.

Just as caloric showed the necessary place of both the imagination and scepticism in an active natural philosophy, so too had the ubiquity of imponderable matter theories challenged the ontological and epistemological order proposed by Newtonianism. According to Larry Laudan, the eighteenth-century tendency to explain "virtually every … physical process" by framing them as subtle fluids "moved well beyond the inductive, observational bounds imposed by erstwhile Newtonians."[28] Indeed, imponderable matter theories "invariably violated the prevailing epistemological and methodological strictures of the age". The result, argues Laudan, was a shift in the early nineteenth-century to empirical epistemologies. For too long, imponderable theories had been allowed to circulate without adequate evidence.[29]

Tracing these evolving conceptions of mind and matter is essential because they do not disappear in the nineteenth century. In fact, determinist and imponderable

[25] Ibid., p. 81; 80; 78.
[26] As quoted in Peter Hanns Reill, 'The Legacy of the "Scientific Revolution"' in *The Cambridge History of Science: Volume 4, Eighteenth-Century Science*, ed. Roy Porter (Cambridge: Cambridge University Press, 2003), pp. 23-43 (p. 39).
[27] Jaffe, *Crucibles*, p. 76.
[28] Larry Laudan, 'The medium and its message: a study of some philosophical controversies about ether' in *Conceptions of Ether: Studies in the history of ether theories 1740-1900*, eds. G. N. Cantor and M. J. S. Hodge (Cambridge: Cambridge University Press, 1981), pp. 157-86 (pp. 158-59).
[29] Ibid., p. 159.

theories are incorporated into Victorian ontology and underwrite one of its central tensions. More stringent empirical standards in the nineteenth century produced increasingly accurate measurements of matter, force and systems—lending support to those, such as Francis Galton, who believed in mechanical determinism. Yet the failure to quantify other phenomena reaffirmed the intangible world of matter out of sight. As James Clerk Maxwell wrote in 1871: "far beyond the visible spectrum" exist "wavelengths [of light] of less than 200 millionths of a millimetre, which are quite invisible to our eyes and quite undiscoverable by our thermometers".[30] Embroiled in contradictory ways, mechanical determinism and imponderability theories (along with aspects of romanticism) informed Victorian notions of matter, making them at once more evidentially grounded *and* increasingly speculative. As the following pages argue, the tendency to overemphasise empiricism in studies of the Victorians' interactions with matter has obscured the more absurd, pseudoscientific and implausible aspects of their thought.

Empirical epistemologies

By the early nineteenth century, reason had evolved to incorporate both the imagination and empirical scepticism in its quest for physical and metaphysical truth. Imponderable theories had shown that theory needed to account for the invisible realm of matter. But the ubiquity of these hypotheses and the rejection of phlogiston also emphasised the need for greater experimental evidence and a unified mathematical language. As Laudan argues, by the 1830s, empiricism was established as the dominant epistemological paradigm.

This claim is broadly adopted by a number of historians. George Levine, for example, suggests that literary realism emerged from efforts "to reconcile empirical

[30] James Clerk Maxwell, *Theory of Heat* (London: Longmans, Green and Co., 1902), p. 239.

science with metaphysical truth."[31] In his study of Joseph Conrad's novels Ludwig Schnauder claims: "[what] the great Victorian successes … have in common and without which they would have been impossible is a certain approach to reality characterised by empiricism, materialism, and determinism."[32] P. M. Harman, meanwhile, argues that the abandonment of imponderable fluid theories "constituted one of the most significant developments in the transformation of physics in the early nineteenth century."[33] Having entertained deductive speculation for too long, nineteenth-century physicists and engineers sought to relocate scientific research within a unified empirical framework:

> In emphasising quantitative, exact experimental methods, and a mathematical unified physics that bridged the disjunction between mechanics and other physical phenomena, … physics established objectives … that were to dominate the creation of a unified science of physics in the nineteenth century. The ideals of mathematisation, quantitative experimentation, and a unified physical world view … shaped the development of nineteenth-century physics.[34]

The foundation of the British Association for the Advancement of Science (BAAS) in 1831 further contributed to the unification, professionalisation and popularisation of scientific research. It was at the 1833 meeting of the BAAS that William Whewell coined the term 'scientist', partly as a satirical response to what he felt was the "increasing … separation and dismemberment" of knowledge into specialised branches.[35] A year later, the term entered into public circulation through its appearance in Whewell's anonymous review of Mary Sommerville's *On the Connexion of the Physical Sciences*. One of the BAAS's most important contributions to the practice of science was the introduction of standardised electrical units and more clearly defined

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[31] Levine, *The Realistic Imagination: English Fiction from Frankenstein to Lady Chatterley* (Chicago: University of Chicago Press, 1981), p. 10.
[32] Ludwig Schnauder, *Free Will and Determinism in Joseph Conrad's Major Novels* (Amsterdam and New York: Rodopi, 2009), p. 43.
[33] P. M. Harman, *Energy, Force and Matter: The Conceptual Development of Nineteenth-Century Physics* (Cambridge: Cambridge University Press, 1982), p. 19.
[34] Ibid., p. 19.
[35] William Whewell, 'Review: *On the Connexion of the Physical Sciences*', *Quarterly Review,* 51 (1834), 58-61 (p. 58).

technical terminology. Harman argues that in rejecting the speculative excesses of imponderable fluid theories and establishing these more stringent methodological rules, nineteenth-century notions of matter were grounded in empiricism.

Of course, the tendency to 'over-empiricise' derives in part from the Victorians' own tendency to do so. According to a commentator writing in *Blackwood's Magazine* in 1874, "[o]ur modern scientists … rejoice in the great achievements of the scientific mind, and laud and magnify their own share in them."[36] T. H. Huxley, for example, presenting a retrospective analysis of nineteenth-century scientific thought, claimed that "during the last fifty years", "all [the] branches of science" had "yield[ed] practical fruits" that were to the utilitarian benefit of humankind.[37] Indeed, the "wonderful increase of industrial production … the improvement of old technical processes and the invention of new ones, … [and the] rapid and vast multiplication of the commodities and conveniences of existence" established Victorian science as the pinnacle of all human achievement.[38] It was not simply a powerful expression of the rational mind's ability to tame matter. It also directly improved the lives of British people by raising "the general standard of comfort", checking "the ravages of pestilence and famine" and "strengthening … the forces of the organisation of the commonwealth against those of political or social anarchy".[39] While Harman, Laudan and others are not incorrect to assert that the unification of science and cultural thought under an empirical epistemology heralded a new era of intellectual, professional, technological and methodological maturity, it is, this thesis argues, one side of a more complex story.

Constrained by these narrow historiographical parameters, critical studies have only recently begun to pay attention to the non-empirical, speculative, and imaginative contradictions of the Victorians' relationship with their material world. In fact, the Victorians, to a greater extent than any prior generation, began to doubt their powers of

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[36] Anon., 'Modern Scientific Materialism', *Blackwood's Edinburgh Magazine*, 116 (1874), 519-539 (p. 520).
[37] T. H. Huxley, *Collected Essays, Volume 1: Methods and Results*, 9 vols (Cambridge: Cambridge University Press, 2011), I, p. 42; 122.
[38] Ibid., p. 42.
[39] Ibid., pp. 42-43.

rational thought. Faced with a world of intangible material complexity, poetry, bodily expression and the fantastical became even more essential to the formulation of new concepts. For example, the speculative excesses of eighteenth-century imponderability theories showed the need for greater standards of evidence. But imponderable substances were not discarded altogether. Instead, they were subsumed within a single hypothesis—the luminiferous ether. And, as Chapter Two demonstrates, the ether, a speculative concept in its own right, provided for Victorian scientists a framework with which they could account not only for the mechanical propagation of light, electricity and magnetism, but also the metaphysical propagation of spiritual entities. The critical prominence given to empiricist and realist modes of thought thus occludes the conflicted role of doubt in nineteenth-century materialist epistemologies. Recognising their own cognitive deficiencies and the inability of inherited scientific ideas to provide an adequate account of dynamical phenomena, Victorians maintained an ambivalent attitude towards the unknown. Sometimes they responded with creative fictions that blurred the boundaries between science and pseudoscience; other times, matter's mysteries produced sublime expressions of terror and awe.

In a lecture delivered at the Athenaeum in 1835, later abridged and reprinted in the quarterly journal *The Analyst*, royal surgeon W. Addison contemplates both the wonder and bewilderment encountered by natural philosophers in the course of their researches. "In the study of Astronomy," he writes, "the imagination wanders through infinite realms of space, occupied by masses of matter in magnitude, and in the rapidity of their motions, beyond the feeble powers of our finite comprehension."[40] Although surely unintentional, the homophonic parallel between 'wanders' and 'wonders' neatly encapsulates the emerging duality of nineteenth-century scientific investigation, in which the imagination, exploring new intellectual territory is nonetheless prostrated by material magnitude. Wandering produces wonder—but it is a wonder born not from the

[40] W. Addison, 'On the combinations of oxygen, with the non-metallic combustibles', *The Analyst*, 2:7 (1835), 58-60 (p. 58).

power of the mind to impose rational order onto the world, but rather, the world's capacity to expose the "feeble powers of our finite comprehension".

The tension here between imaginative inference and the empirical observation culminates with an expression of science's ability both to enlighten *and* humble.[41]

> The farther we advance in any branch of the study of Natural Philosophy, the more its circle, instead of closing on us, widens; when we reach some distant but seemingly fixed point where we thought to terminate a definite object of inquiry—then the boundaries recede—fresh objects and novel contemplations pour in upon us on every side, multiplying and becoming more wonderful and more worthy of our attention at every step. From these accumulating scenes the humble man (and true philosophy will make its votary humble) learns the little that he can.[42]

Although the notion that scientific investigation constitutes a religious undertaking—the natural philosopher is positioned here as "votary"—gone are the idealistic certainties of the Newtonian archetype. A fixed worldview is impossible to maintain in a world that constantly forces the boundaries of knowledge to evolve. Subtly rejecting the conception of the universe as a mechanical system, Addison transforms late eighteenth and early nineteenth-century romantic discourses by conjoining the sensibility of wonder with epistemic uncertainty. Thus, humbled by freshly multiplying objects and novel contemplations, the mind is invigorated by an epistemology encompassing both empirical immediacy and imaginative expansion.

Matter over mind

This gradual shift in nineteenth-century scientific discourses, in which Newtonian authority and eighteenth-century imaginative speculation is assimilated into a more conflicted sense of sceptical wonder, emerges from a penumbral region of uncertainty. The history of science—in so many ways a history of the relationship between thought

[41] Laudan, 'The medium and its message', p. 181.
[42] Addison, 'Combinations of oxygen', pp. 59-60.

and matter—shows that discovery was a process of creation as much as it was a process of detection. As the nineteenth century progressed, doubt and the imagination became integral to how the Victorians interacted with matter. Everyday yet materially elusive phenomena—heat, light, magnetism, temperature, pressure and speed—proved to be more imponderable than even eighteenth-century natural philosophers had imagined. Darwin's theory of evolution suggested that matter had the capacity to create increasingly complex life morphogenetically. Geologists realised that the layered and sedimented composition of the earth revealed a planet "that was millions of years older than humankind."[43] And the consolidation of the laws of thermodynamics suggested that no matter what humans did to intervene, the material world would inevitably degrade.

With this turn to intensive processes that seemed material yet *incorporeal*, thought became increasingly diversified, unstable and fractious. As sepoys mutinied against the British in the late 1850s, material stuff was also acting with recalcitrance. The transatlantic telegraphic cable project of the late 1850s was plagued by problems. William Thomson, the senior engineer at the British end of the cable, was locked in disagreement with Wildman Whitehouse, the chief engineer at the Eastern end, as to how the cable should operate. Subjected to fluctuating voltage levels (Thomson believed only a low voltage was necessary to transmit electrical pulses, Whitehouse a high voltage), the cable's insulation began melt. By mid September 1858, the cable had completely failed. Thomson wrote to James Prescott Joule during this time, complaining of the problems that had vexed the project and his growing frustration with "the dull and heartless business of investigating the pathology of faults in submerged conductors."[44] And yet, even though the actual operation of the cable was problematic, Thomson was still energised by the project. In his letter to Joule he added: "[the] instantaneous exchange of ideas between the old and new worlds, possesses a

[43] Adelene Buckland, *Novel Science: Fiction and the Invention of Nineteenth-Century Geology* (Chicago and London: University of Chicago Press, 2013), p. 224.
[44] William Thomson, letter to J. P. Joule, 25 September 1858, in Silvanus P. Thomson, *The Life of William Thomson*, 2 vols (London: Macmillan and Co., 1910), I, pp. 378-79 (p. 379).

combination of physical and (in the original sense of the word) *metaphysical* interest [emphasis original]".[45]

Curiously, the emergence of more stringent empirical standards in Victorian science thus served to emphasise the importance of metaphysical intuition. In finding inherited ways of thinking unable to account for the strange world being continually discovered and created around them, scientists were forced to invent new words, appropriate discourses from other departments of inquiry and think outside phenomenological confines. Early expositors of thermodynamics, for example, developed novel ways of communicating the new physics of energy to their audiences. By "insinuating an analogy between the social and physical world," Balfour Stewart and Norman Lockyer hoped to explain energy by likening it to the "power" of man to overcome obstacles, perform work and raise "himself and his family into a position of advantage." [46] In the making of scientific fact, imaginative fiction, literary experimentation and bodily performativity interacted with each other in surprising ways.

While the new scientific discourses that emerged in the nineteenth century borrowed tropes and devices from literature—analogy, metaphor, metonymy, poetry, and allegory—they were also literary in their own right. As Adelene Buckland notes, for Victorians, literature "was not yet a category that excluded nonfiction" and scientific writing was "read and consumed by the many rather than the few".[47] Indeed, new ideas about matter were not limited to esoteric scientific publications that were financially and intellectually inaccessible to the general public. In fact, technological innovations in the press, the reduced cost of production, and the rise of middle class literacy meant that reading habits in the nineteenth-century shifted from "the regular, repeated reading of a few expensive texts by a few privileged readers to the rapid consumption of

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[45] Ibid., p. 378.
[46] Balfour Stewart and Norman Lockyer, 'The Sun as a Type of the Material Universe, Part II,' *Macmillan's Magazine*, 18 (1868), 319-327 (p. 319).
[47] Buckland, *Novel Science*, p. 14.

a wider range of cheaper ones by a broader audience".[48] Elizabeth Leane observes that these widespread changes intersected with the "increasing specialization of science" to facilitate "the development of a mass market for popularizations."[49] Indeed, the "public consumption of science in museums, zoos, exhibitions and lecture halls was complemented by the private consumption of popular science books, which catered for a variety of budgets and tastes."[50] Concomitantly, books and periodicals "were [also] a prominent site for the popularization of science". Many of these popularisations were written by specialists but a great deal were also penned by "expositors who were not themselves scientists."[51] As Buckland thus argues, novels, essays and poetry "had a vital role to play in creating … modern science, both by attracting new readers and by shaping the artistic and literary conventions by which [new concepts] could be understood."[52]

But the creation and transmission of scientific ideas through the reappropriation of literary conventions was a not unidirectional process. Scientific principles were themselves transformed into rhetorical tropes imbued with moral meaning in order to produce "a plentiful crop of analogies, allegories, parables, and proverbs".[53] Theoretical notions of conservation and dissipation played into wider cultural anxieties about storage, preservation and decay. Human perception was conceived as analogous to the electrical relays of communication networks. And while Thomson's theoretical vortex atoms—microscopic whirling eddies in the perfect ethereal fabric of space—emerged from a combination of Helmholtz's research in hydrodynamics and the convoluted topological knots of the 'Tait conjectures', they were

[48] Mary Hammond, 'Readers and readerships' in *The Cambridge Companion to English Literature, 1830-1914*, ed. Joanne Shattock (Cambridge: Cambridge University Press, 2010), pp. 30-49 (p. 30).
[49] Elizabeth Leane, *Reading Popular Physics: Disciplinary Skirmishes and Textual Strategies* (Aldershot: Ashgate Publishing, 2007), p. 21.
[50] Ibid.
[51] Ibid.
[52] Buckland, *Novel Science*, p. 14.
[53] Ibid., p. 319.

also used as a springboard to launch even more speculative ideas.[54] In fact, Tait (along with Stewart) claimed Thomson's vortex atoms provided the mechanical action in the ether by which the soul could be preserved and transmitted to an unseen divine universe. In using Thomson's hypothesis to predicate a pseudoscientific theory, Tait inadvertently reappropriated his own topological knots in a fantastical context.

Hence, while matter *instigated* new modes of thought, scientific theories were also *used* to explore these changing epistemological concepts. If matter was for George Eliot a "lofty abstraction" then for many writers it was "more earthly, / Actual, less ideal".[55] It concretised, that is, ideal and metaphysical problems. For example, entropy—the tendency for energy to become increasingly degraded—was a concept that disturbed many Victorians as it heralded the inevitable heat death of the cosmos and all life within it. Jude V. Nixon has shown that the poems of Gerard Manley Hopkins employ energetic tropes to explore thermodynamic anxieties. Hopkins' "convergent way of understanding the world," argues Nixon, "manifests arguably the most heterogeneous display of nineteenth-century popularization of thermodynamics and reflects its most intense apocalyptic angst."[56] Similarly, Christina Rossetti's 'Summer is Ended' (1881) is distinctly entropic in its description of death as an unstoppable tide of material decay. "To think", the poem's speaker wonders, "that this meaningless thing was ever a rose". This dead lump of inert matter, "[s]centless, colourless"—that "*this*" was ever a living thing is surely impossible.[57] The rose's innate rose-like qualities have decayed, leaving only a material trace of what it once was. And yet these qualities—scent and colour—were themselves material. The same degenerative tendencies, she continues, manifest in every aspect of life, from our physical bodies to "our bliss":

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[54] The 'Tait conjectures' are three mathematical statements (now proven) regarding concepts in knot theory.
[55] George Eliot, *George Eliot: A Critical Study of Her Life, Writings and Philosophy*, ed. George Willis Cooke (Cambridge: Cambridge University Press, 2010), p. 134; Arthur Hugh Clough, 'Amours de Voyage' in *The New Oxford Book of Victorian Verse*, ed. Christopher Ricks (Oxford: Oxford University Press, 1987), pp. 229-62 (p. 231).
[56] Jude V. Nixon, '"Death blots black out": Thermodynamics and the Poetry of Gerard Manley Hopkins', *Victorian Poetry*, 40:2 (2002), 131-56 (p. 149).
[57] Christina G. Rossetti, 'Summer is Ended' in *The New Oxford Book of Victorian Verse*, p. 300.

> Tho' we care not to wait for the end, there comes the end
> Sooner, later, at last,
> Which nothing can mar, nothing can mend:
> An end locked fast,
> Bent we cannot re-bend.

Aside from directly engaging with scientific notions of matter to reframe contemporary problems, poetry and novels also adumbrated advances in science. Somehow, writers were able to see in the world something which had not yet entered into common knowledge and been verified as objective fact. John Tyndall, for instance, heralded the following lines from *Sartor Resartus* (1836) as proof of Thomas Carlyle's precognitive powers:

> That little fire which glows star-like across the dark-growing moor … is it a detached separated speck, cut off from the whole universe; or is it indissolubly joined to the whole? Thou fool, that smithy-fire was primarily kindled at the sun … Detached, separated! I say there is no such separation; nothing hitherto was ever stranded, cast aside; but all, were it only a withered leaf, works together with all, and lives through perpetual metamorphoses.[58]

For Tyndall, passages such as these scattered throughout *Sartor Resartus* proved that "Carlyle … poetically, but accurately, foreshadow[ed] the doctrine of the Conservation of Energy".[59] Tyndall certainly overplays Carlyle's poetic adumbration of the first law of thermodynamics. The men were close friends and Tyndall was keen to lend poetic support to his own metaphysical interpretation of the principle of conservation. But as modern critics have argued, if the articulated is condensed from what is previously unarticulated—if, that is, known utterances derive from nebulous subconscious and inchoate sensation—then it stands to reason that things which have not yet been said scientifically have nonetheless been said in other ways.

[58] As quoted in John Tyndall, *New Fragments* (Cambridge: Cambridge University Press, 2011), p. 386.
[59] Ibid.

Matter—the fiery metamorphoses of Carlyle's intermeshed universe, the nervous fibres of the body, curious foreign objects, the fossils of dead life forms and the fetid oceanic ooze in which they once writhed—permeated both 'scientific' and 'literary' texts alike. But while literature (in the canonical sense) imbibed scientific ideas, it also became 'scientific'. Non-specialist texts—essays, novels and poems—were used to push thought in new directions and experiment with the plasticity of language. Moreover, these new modes of thought, and the texts they created, were themselves material and entwined with spatiotemporal processes. The publication rhythms of a particular periodical, for example, the quality of its paper matter and its propensity to decay, its passing between different readers—these variables changed what a text could do and how it did it. Likewise, the ideas being created by Victorians were not static, immaterial constructs. They emerged from bodily experimentation, or the manipulation of stuff, or collaborative communication between humans and nonhumans. They were dissected, reformulated and rewritten; they could act with partial autonomy, creating meaning that their authors had not intended.

Saying that thought and language have a material dimension might appear counter-intuitive. But as Michel Serres argues, language is caught in corporeal, symbolic and spatial negotiations continually taking place through time:

> [L]anguage is formulated and reformulated by the transformation of the message, the channel, and the noise … what was supposed to interfere begins constructing; obstacles combine to organize. … [T]his occurs from the depths of the molecular chaos, in which information appears in its spatial simplicity and material forms. … The body is an extraordinarily complex system that creates language from information and noise, with as many mediations as there are integrating levels.[60]

Thus, when Victorian physicist John Tyndall describes his mountaineering adventures with the intention of provoking a bodily response in his readers, complex interactions

[60] Michel Serres, *Hermes: Literature, Science, Philosophy*, eds. Josue V. Harari and David F. Bell (Baltimore and London: The Johns Hopkins University Press, 1982), pp. 80-82.

between raw experience, memory, language and information take place before even a single word is put to paper. Produced from material encounters, combining with thought, texts produce information in excess of their constituent terms and physiologically affect bodies.

This thesis digs up and traces these emergent shoots—the ontological turns, conceptual upheavals and contradictory impulses all connected by this irreversible shift in the way the Victorians understood material reality. If the story of the Victorians' relationship with matter has tended to overplay the role of empiricism, then this thesis attempts to restore some balance by framing these new modes of thought as themselves spectrally material and driven by paradoxical, divergent and at times nonhuman forces. It is concerned as much with failure as it is with success: with the inability of Victorians to find equilibrium with the material world and the sometimes negative reactions they had to the threat of existential dispossession. Victorian scientists and non-scientists frequently delved into speculative spaces defined by no unified epistemological strategy. Indeed, multiple epistemologies competed with one another as matter revealed itself to be more, not less resistant to control.

In his famous and controversial conclusion to *The Renaissance* (1873), Walter Pater wrote of the sinewy connective tissue—"phosphorus and lime and delicate fibres"—binding subject and object, experience and external matter in constantly changing arrangements:

> Our physical life is a perpetual motion … the passage of the blood, the wasting and repairing of the lenses of the eye, the modification of the tissues of the brain by every ray of light and sound. … Like the elements of which we are composed, the action of these forces extends beyond us; it rusts iron and ripens corn. …That clear, perpetual outline of face and limb is but an image of ours, under which we group them—a design in a web, the actual threads of which pass out beyond it. … At first sight experience seems to bury us under a flood of external objects, pressing upon us with a sharp and importunate reality, calling us out of ourselves in a thousand forms of action.[61]

[61] Walter Pater, *The Renaissance: Studies in Art and Poetry* (London: Macmillan and Co., 1888), pp. 246-47.

If Pater's "delicate fibres" building a web across, between and through all matter is the *ontological* image connecting the works discussed in this thesis, then his description of the turbulent "swarm of impressions" is perhaps the *epistemological*.[62] As the cogito's influence waned, "the mysterious control of Mind by Matter" became increasingly powerful.[63] In each of the texts I discuss, the newfound intensive qualities of matter force thought to transform in imaginative, contradictory and sometimes profoundly disturbing ways. Speed and pressure, concentration and temperature, morphogenetic self-organisation, atoms vibrating with unseen fervour and intangible forces wending through time—these complex, *intensive* material processes, coalescing into solid form then "vanishing away" provoke and combine with the "strange, perpetual, weaving and unweaving" of Victorian thought.[64]

Deleuze's intensive ontology

So far, the term 'intensive materialism' has been adumbrated but not specifically defined. In providing a more theoretical description, it is worth beginning by defining what it absolutely is not. Materialism, writes Maureen Moran in her wide reaching intellectual survey of Victorian Britain, is "a belief that the physical world and laws of matter constitute the sole reality. Materialism rejects God, immortality and the supernatural."[65] She continues:

> The phenomenon of materialism shows how science replaced religion as a source of knowledge in the nineteenth century, even though many Victorians such as Tennyson … worried that materialism reduced humanity to an animal species.[66]

[62] Ibid., p. 248.
[63] John Tyndall, *Address Delivered Before The British Association Assembled at Belfast, With Additions* (London: Longmans, Green, and Co., 1874), p. 54.
[64] Pater, *Renaissance*, p. 249.
[65] Maureen Moran, *Victorian Literature and Culture* (London and New York: Continuum, 2006), pp. 144-45.
[66] Ibid., p. 145.

This is a perfectly fine description of ‘rank’ or deterministic materialism and the intensive materialism discussed throughout this thesis engages with this discourse. But while some Victorians embraced deterministic materialism many more rejected it. In fact, both Christians and non-Christians alike—those such as John Tyndall and Frederic Harrison who were cast by their contemporaries as determinists—believed reality could not be encompassed by such a reductive notion of matter. Although for these non-Christians matter constituted everything in the universe, from the workings of the mind to the stars of outer space, it was still imbued with an immanent, mysterious power that could not be constrained by thought. While incorporating Newtonianism and eighteenth-century theories of imponderability, nineteenth-century epistemology had to respond to this increasingly complex material world. Matter might be everything—but it was also absurd, potentially unquantifiable and capable of inducing numinous feeling.

If Moran’s notion of materialism—and by extension matter—is restrictive, then the first question to address is, what is *intensive* matter? Thus far I have suggested that the intensive world the Victorians found and created encompassed qualities of temperature, speed, pressure and motion, organic and nonorganic morphogenesis, and orogeny. Turning to the work of twentieth-century French philosopher Gilles Deleuze elucidates what exactly makes these things intensive. Although many modern critics identify Deleuze as a post-structuralist, he in fact resisted many of the tendencies of his contemporaries by reinvigorating a truly material conception of reality. Contrasting thought produced by the state, whose function is to separate, regulate and order the world into logical axioms, with ‘nomadic’ philosophy, Deleuze traced a radical ontology and epistemology of material differentiation.

For Deleuze, the external world exists independently of the mind: a claim that is a source of liberation. In the 1940s and 1950s, the phenomenology of G. W. F. Hegel had re-emerged alongside structuralism to dominate French philosophical thought.[67] Hegelian philosophy claimed that the world could be subsumed within a grounding universal identity, or transcendental Being. Everything, ultimately, could be known through phenomenal contemplation and categorisation. Deleuze's philosophy is partly a response to this idealist strain of thought. On the other hand, it is also a reaction to other realist philosophies. The most famous realist philosopher, Plato, maintained that the things populating reality are fully formed entities separate from the mind. But Plato also argued that what gave material things their identity was an ideal essence or 'Form'. A table is table-like because it derives from the perfect, non-mental, non-temporal and non-spatial archetype of the perfect table.

Deleuze also rejects this view of reality. Instead of conceiving 'difference' as comparative variation between identities, he argues that difference is constitutive. To put this another way: intuitively, we tend to look at things and think of them as being different from one another. But for Deleuze, difference, rather than being a statement of negation (x is not like y), is productive. "Everything which happens", Deleuze writes, "and everything which appears is correlated with orders of differences: difference of level, temperature, tension, potential, *difference of intensity* [emphasis original]."[68] Intensive space is the zone in which these abstract differential relations come to be actualised in space. It is what determines, for example, cell divisions at singular critical thresholds in the development of an embryo. Though a great deal of localised variables determine how embryonic development unfolds, the intensive determines the possible limits of differentiation, or the average equilibrium state: that is, why certain cells will produce a human embryo and not another animal. As soon as intensive processes manifest in the actualisation of form, the bonding of chemicals, the bifurcation from laminar to turbulent flow, "[d]ifference is cancelled qualitatively and in extension."[69] The intensive has not disappeared. Rather, like the complex historical antecedents

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[67] Claire Colebrook, *Gilles Deleuze* (London: Routledge, 2002), p. 3.
[68] Gilles Deleuze, *Difference and Repetition*, trans. Paul Patton (London: The Athlone Press, 2004), p. 222.
[69] Ibid., p. 335.

leading to a single event in time it is realised in the material conditions of that moment. Thus, for Deleuze, things do not have a stable, innate identity. Instead, they are composed of a flux of continually changing material, spatial and temporal processes.

To clarify the distinction he makes between intensive and 'extensive' properties, Deleuze draws from Victorian thermodynamics: one of the first branches of thought, he believes, to conceive of matter in differential terms. Extensive properties refer to material bodies actualised and extended in time and space. These can be defined in terms of quantity: mass, length, area, volume, the amount of energy in a system, and so on. Extensive properties can be divided to form two separate units. For example, if a Victorian engineer were to take a metal pipe from a steam engine and cut it in half, s/he would be left with two smaller pieces, each defined by a new set of extensive properties. On the other hand, intensive properties refer to attributes such as the pressure and temperature of steam produced in an engine's boiler. Such spaces, Manuel DeLanda notes, "are also bounded but in a different way, the limits of one zone marked by *critical points* of temperature, pressure, gravity, density, tension, connectivity, points defining abrupt transitions in the state of [matter] [emphasis original]."[70] Deleuze claims that intensive properties are *indivisible* and tend to average out during division to an equilibrium state. Imagine, for instance, our Victorian engineer's piece of divided pipe is painted a particular shade of red. Cutting the pipe in two does not affect the saturation, brightness or hue of the redness: the colour remains exactly the same. Or, to use DeLanda's analogy: "a gallon of water at ninety degrees can be divided in extension … but the two parts will not each have half the temperature."[71] Victorian thermodynamics, Deleuze argues, was radical in its understanding of how intensive and extensive material processes converge. Indeed, the intensive threshold at which matter undergoes a phase transition—from, for instance, liquid water to steam—was crucial to nineteenth-century physicists' theoretical knowledge of engines.

[70] Manuel DeLanda, 'Space: Extensive and Intensive, Actual and Virtual' in *Deleuze and Space*, eds. Ian Buchanan and Gregg Lambert (Edinburgh: Edinburgh University Press, 2005), pp. 80-88 (p. 80).
[71] Ibid., p. 81.

Nevertheless, Deleuze argues, Victorian thermodynamics still tended to overlook intensive processes in its preoccupation with final state equilibrium (entropy) in closed systems. Chapter Three in fact challenges this assumption. Critics such as N. Katherine Hayles have shown that James Clerk Maxwell's famous thermodynamic heuristic colloquially known as 'Maxwell's Demon' anticipated the connection between entropy and information theorised in the twentieth century. Chapter Three goes further, however, arguing that Maxwell's poetic and scientific 'thermodynamic analogies' produced negentropic information (emergent pockets of counter-entropic order) precisely because they were predicated on far-from-equilibrium intensive thresholds operating in *open* systems. This point aside, Deleuze still claims that nineteenth-century scientists had a profound understanding of intensive material processes—not simply in thermodynamics but other branches of thought such as Pierre Curie's Principle and evolutionary biology. Deleuze continues to describe the intensive in increasingly complex ways that are not particularly relevant to this thesis. However, there are two further aspects of the intensive that need to be expanded upon.

First, aside from being indivisible, intensities vary in degree. The processes driving volcanic eruptions are more volatile than those in dormant volcanoes. The same is true of lived experience. In the transition from a state of emotional equilibrium to one of extreme pain or joy, the body passes through different material thresholds to adopt temporarily a new physiological condition. Intensive processes produce both states. But the physiologically agitated state—the one further removed from stable equilibrium—involves greater degrees of intensive differentiation. Intensity is thus largely synonymous with difference, to the extent that considering the idea of "difference[s] of intensity" is practically tautological: "[e]very intensity is itself differential, by itself a difference".[72] Second, intensities are temporal as well as spatial and drive material change on their own *and* in multiplicitous groupings of singularities. The human body is a nested set of overlapping and constantly changing temporal

[72] Deleuze, *Difference*, p. 281.

intensities: circadian rhythms determining sleep/wake cycles; processes of digestion; replenishment of hair, nails and skin; changes to breathing and heart rate in response to environmental variables; menstrual cycles, and so on. All of these actual processes are, for Deleuze, determined by different temporal intensities. Such bodily mechanisms are not guided by homogenous, linear time but instead by complex multiplicities comprised of differential speeds, rhythms and cycles.

This thesis' examination of nineteenth-century intensive matter encompasses these Deleuzian notions of intensive ontology. From the undulatory propagation of electromagnetic forces to the organic processes driving evolution, the Victorians' material world was defined by intensities. While it might seem theoretically anachronistic to use Deleuzian ontology in a Victorian context, Deleuze articulates and develops numerous ideas that were already in circulation during the nineteenth century. As demonstrated, his notion of extensive and intensive properties is drawn from classical thermodynamics. But many Deleuzian ideas also emerge from other branches of nineteenth-century thought. His concept of differential repetition is a reformulation of Nietzsche's eternal return; Henri Bergson's pure duration underlines Deleuze's cinematic paradigm of movement-images and time-images; in their spatial construction, Deleuzian multiplicities are an almost like-for-like appropriation of nineteenth-century mathematician Georg Bernhard Riemann's n-dimensional manifolds, and so on. Deleuze focused on nineteenth-century scientific, literary and philosophical thought precisely because it was so radical.

Claire Colebrook is right in claiming that Deleuze's "new grammar of philosophy" was "a new grammar of thinking".[73] At the same time, however, Deleuze would also be the first to say that new thinking does not require the existence of new linguistic, conceptual or philosophical models. In fact, his wild empiricism, decentring phenomenological being and incorporating bodily experimentation and nonhuman expressivity, affirms the divergent ontology of intensive matter that was encountered

[73] Claire Colebrook, *Philosophy and Post-structuralist Theory: From Kant to Deleuze* (Edinburgh: Edinburgh University Press, 1999), p. 229.

by the Victorians. Nineteenth-century scientists and writers were already articulating these ideas. But because they did not have the conceptual vocabulary afforded to Deleuze and because these concepts were entirely new, they expressed them in complex, sometimes confused ways.

Intensive materialism, as a varied set of epistemological practices encompassing thought, language and body, thus emerges from this new view of matter not as ordered and stable but inherently intensive. Intensive materialism is not a unified, self-contained philosophy predicated on logical statements and axioms. Rather, it is a multiplicity comprised of overlapping epistemological singularities. Victorian expressions of intensive materialism are vastly divergent. What unites them, however, is their shared recognition of and response to the world of intensive matter. Indeed, the stories of nineteenth-century intensive materialism are as much about the failure of humans to make sense of this world as much as their ability to comprehend it. "Intensity," Deleuze writes, "is simultaneously the imperceptible and that which can only be sensed."[74] Articulating in words the intensive—something felt as an affect, something indivisible and resisting quantification, and something observed only through extensive actualisation—is a process necessarily fraught with complication. Hence, while Deleuze outlines a radical form of empiricism, I tend to avoid using this as an epistemological framework to analyse Victorian materialism. Rather, intensive matter, articulated with philosophical clarity by Deleuze but experienced and pondered over by the Victorians, is positioned as the primary phenomenon driving new modes of thought. Intensive matter, put simply, forced the Victorians to think intensively.

[74] Deleuze, *Difference*, p. 230.

Critical turns

In addition to the intensive matter that was transforming nineteenth-century thought, this thesis also engages with recent turns in critical theory. Many critics have traced the non-empirical, speculative and imaginative interconnections of Victorian science and literature. Gowan Dawson and Bernard Lightman have drawn attention to how scientists' reputations and their characterisation in the periodical press affected the public acceptance of scientific theories. Gillian Beer and Bruce Clarke, meanwhile, have examined how the interplay between nineteenth-century literary and scientific cultures produced ideas that were reappropriated and transformed by Victorian readers. And Crosbie Smith has painstakingly documented the historical emergence of energy physics, arguing that its cultural credibility depended on the reformist efforts of a group of 'North British' physicists (Maxwell, Tait and Thomson, to name a few).

The two studies with which my research most closely overlaps are Barri J. Gold's *ThermoPoetics* (2010) and Daniel Brown's *The Poetry of Victorian Scientists* (2013). In *ThermoPoetics*, Gold argues that nineteenth-century physics and literature "engage[d] in mutually productive conversation[s]", to "shape … the development and dissemination of scientific ideas."[75] Echoing Tennyson's *In Memoriam*, Maxwell claimed that Michael Faraday's 'lines of force' would "'weave a web across the sky'".[76] Similarly, Gold argues, *In Memoriam* anticipated thermodynamics in its poetic exploration of the "conservation of memory" while works by Dickens, Stoker and Wilde engaged with concepts of entropy, phase transition, and reversibility.[77] The poetry of Victorian scientists is, unsurprisingly, the focus of Brown's *The Poetry of Victorian Scientists* (2013). "An oddly neglected body of work," the playful, lyrical and satirical verse of nineteenth-century physicists offers for Brown a "unique record of the nature

[75] Barri J. Gold, *ThermoPoetics: Energy in Victorian Literature and Science* (Cambridge, MA: The MIT Press, 2010), pp. 16-17.
[76] Ibid., p. 16.
[77] Ibid., p. 34.

and cultures of Victorian science."[78] Tracing the transformation of scientific ideas into poetry, Brown also demonstrates how physicists used poems as conceptual instruments. From poetic experimentation emerged lively analyses of the epistemological, moral and technical inconsistencies of contemporary scientific ideas alongside codified ripostes to detractors. While Brown's meticulous, even obsessive attention to detail is at times overwhelming, his scholarly scope is to be admired. To be sure, his book informs one of the central claims of this thesis: that poetry both creates and destabilises science through its nonsensical and non-logical characteristics.

This thesis builds on these important works. But where it departs from them is in its claim that thought, language and texts are themselves ontologically material and driven by nonhuman processes. Victorian writing, it claims, is not simply a record of theories and impressions; it also functions with partial autonomy. In other words, this thesis is not simply about how intensive matter appears in scientific and literary texts. It also shows how literature and thought function intensively—how they exceed the bounds of intention.

In *ThermoPoetics*, Gold notes that we are "lucky that interdisciplinarity is in vogue at the moment."[79] Perhaps the current quality of interdisciplinary research derives from its engagement with life's actual messiness. Rarely do ideas develop in isolation, bounded by disciplinary and institutional borders. As N. Katherine Hayles notes: "of all the interdisciplinary parallels one might notice, only a few will be connected by direct lines of influence".[80] But interdisciplinarity is also a creative enterprise—a form of research that allows critics to think about texts in new ways. In her 1991 University of Cambridge inaugural lecture, Gillian Beer made a similar claim:

> Interdisciplinary studies do not produce closure. Their stories emphasise not simply the circulation of intact ideas across a larger community, but transformation: the transformations

[78] Daniel Brown, *The Poetry of Victorian Scientists: Style, Science and Nonsense* (Cambridge: Cambridge University Press, 2013), p. i.
[79] Gold, *ThermoPoetics*, p. 19.
[80] N. Katherine Hayles, *Chaos Bound: Orderly Disorder in Contemporary Literature and Science* (Ithaca and London: Cornell University Press, 1990), p. 4.

undergone when ideas enter other genres or different reading groups, the destabilising of knowledge once it escapes from the initial group of co-workers, its tendency to mean more and other than could have been foreseen.[81]

Real overlaps exist across different departments of knowledge, suggests Beer. But additionally, the process of exploring these confluences constitutes a transformative act in itself. Like an interaction with the zoetrope, there is the potential for unexpected ideas outside our academic comfort zones to impose themselves on us.

The richness of interdisciplinary research has not always been as keenly felt as it is today. In 1959, C. P. Snow delivered the Rede Lecture at Cambridge titled 'The Two Cultures and the Scientific Revolution'. Drawing from his personal experience as a novelist and scientist, Snow recounts how "constantly I felt I was moving among two groups—comparable in intelligence ... who had almost ceased to communicate at all".[82] Intellectuals from the sciences and humanities were becoming increasingly ignorant about each other's professions: a trend Snow found to be particularly pronounced among literary scholars. Occasionally he would ask "how many of them could describe the Second Law of Thermodynamics"—the scientific equivalent, Snow suggested, of asking, "*Have you read a work of Shakespeare's?*" Invariably, the "response was cold: it was also negative."[83] For Snow, the icy hostility and intellectual discomfort between science and humanities academics was more than an institutional problem. This cultural split was also spreading throughout the "intellectual life of the whole of western society".[84]

Soon after Snow delivered his lecture, critics (most notably F. R. Leavis) were quick to repudiate his claims. Recent academic work of the last three decades has also shown the dynamic conversations that are possible between disciplines—from Hayles' investigations into how chaos inhabits both the metaphorical and literal world of

[81] Gillian Beer, 'Forging the Missing Link: Interdisciplinary Stories', Inaugural Lecture delivered 18 November 1991, (Cambridge: Cambridge University Press, 1992), p. 5.
[82] C. P. Snow, *The Two Cultures and the Scientific Revolution* (Cambridge: Cambridge University Press, 1961), p. 2.
[83] Ibid., p. 16.
[84] Ibid., p. 4.

postmodern scientific and literary cultures, to Carl Kears and James Paz's forthcoming *Medieval Science Fiction*: a collection of essays exploring the possibility of "explosive contact" between medieval literature and the science fiction genre.[85]

In spite of its problems, Snow's argument raises an important question concerning the 'literacy' of scholars attempting to conduct work in a field outside their immediate training. For Glen A. Love—a literary scholar—interdisciplinary research often lacks evidential rigour and is guilty of misconstruing science:

> A scientist may overstate or distort his or her data, but the methodology of the discipline is in place to question and refute and correct those statements. Unfortunately, in the nonsciences, overstating the evidence or obfuscating reality often enjoys a free ride. … We require the standards of evidence and rational thought to move us beyond attractive theories of unreality."[86]

The instinctive response that I, and possibly many others in the humanities, have to this line of argument is, as Stacy Alaimo writes, that it "is both epistemologically impoverished and politically retrograde."[87] For Love, the scientific method is a trans-historical, trans-ideological and trans-cultural enterprise. It operates in largely the same way across cultures and "has achieved its 'exalted' status because it has been successful … in discovering something of how nature works."[88] This is not completely untrue. If it were, we would expect to see noticeable discrepancies between the sciences produced by different nations. Yet the scientific method is still a constructed discourse subject to change over time. The peer review process, experimental procedures, how hypotheses are formulated and tested, what constitutes reasonable evidence, personal bias—all of these aspects of the scientific method are, as I hope this introduction has

[85] 'Medieval Science Fiction: A Roundtable Conversation', in *Arts & Humanities Festival 2013: Being / Human* (King's College London, UK, 25/10/2013). A recording of the roundtable can be accessed from: http://www.kcl.ac.uk/artshums/ahri/eventrecords/2013-2014/Festival/Medieval.aspx [last accessed May 2015]
[86] Glen A. Love, *Practical Ecocriticism: Literature, Biology, and the Environment* (Charlottesville: University of Virginia Press, 2003), p. 45.
[87] Stacy Alaimo, 'Ecology' in *The Routledge Companion to Literature and Science*, eds. Bruce Clarke and Manuela Rossini (Abingdon and New York: Routledge, 2011), pp. 100-111 (p. 109).
[88] Love, *Ecocriticism*, p. 44.

demonstrated, variable. To be sure, the scientific method is the most successful and rigorous process we have for testing empirical observations about our material reality, in spite of being bound up with wider cultural forces. As Gold puts it: “I have never found the constructed nature of facts to be an indictment of their factness”.[89]

Nonetheless, while Love seems to disregard the experimental creativity of interdisciplinary research, he makes an important point. Whereas Snow was concerned that his generation of literary critics were uninterested in science, Love worries that the ubiquity of interdisciplinary work masks a basic misunderstanding of science. For Love, the problem is not whether a non-scientist knows about the second law of thermodynamics. Rather, it is whether her or his understanding of it—likely to be, for the most part, a simplified, non-mathematical approximation—is accurate, detailed and comprehensive enough. “Complexity is what interests scientists,” writes Love, “not simplicity.”[90] Hence, the risk of interdisciplinary research is that it risks overlooking what makes science scientific.

Beer addresses similar concerns in her inaugural lecture:

> How thoroughly interdisciplinary is it possible to be? Are we lightly transferring a set of terms from one practice to another, as metaphor, *façon de parler*? Are we appropriating *materials* hitherto neglected for analysis of the kind we have always used? Or are we trying to learn new *methods* and skills fast, which others have spent years acquiring [emphasis original]?[91]

Beer’s questions get to the heart of the problem. In attempting to engage with disciplines outside our academic training and thinking about problems that to those who deal with them regularly are comparatively simple, we run the risk of confounding both ourselves and others. While we can pick apart the metaphors scientists use, our own metaphorical appropriation of scientific concepts might distort their technical specificity beyond meaningful recognition. This thesis certainly takes that risk. Of

[89] Gold, *ThermoPoetics*, p. 260.
[90] Love, *Ecocriticism*, p. 43.
[91] Beer, ‘Inaugural Lecture’, p. 5.

course, the metaphorical associations used throughout this work are only there because I feel they have adequate evidential and conceptual support. But even if we manage to avoid directly misconstruing science, there is still a great deal of uncertainty about how much insight can be produced from making interdisciplinary connections. In trying to speak to a range of discourses there is the chance of speaking to none. Being wrong, in other words, is only marginally worse than being bland.

Then of course, there is what scientist turned historian and philosopher Thomas Kuhn described as the “personal wrench” felt in “the abandonment of one discipline for another with which it is not quite compatible.”[92] That impression of forcing together two repulsively charged ideas is something I experienced when considering Maxwell’s electromagnetic equations. I had been reading Basil Mahon’s biography of Maxwell, *The Man Who Changed Everything* (2003), and was struck by how gracefully Mahon explained the famous mathematics. Curl and divergence began to unfurl in my mind’s eye, growing from abstract symbols into the flowing manifestations of electrostatic force. Mahon was entirely justified in claiming for these mathematical statements a “beauty and power” that could be seen “even without advanced mathematical training.”[93] Energised by his analysis I saw what I thought was a striking similarity between the formal operations of Maxwell’s equations and one of his poems. I set to work on improving my mathematical knowledge and was soon able to manipulate basic differential equations. But even a rudimentary appreciation of Maxwell’s mathematics proved beyond my grasp—a fact confirmed when seeking help from a friend studying for a PhD in physics. The idea was quickly abandoned.

To my mind, one of the greatest failings of this thesis is that it is nowhere near as interdisciplinary as I originally envisaged. I hope, however, that it still presents a fresh analysis of scientific and literary ideas without perverting their contextual and

[92] Thomas Kuhn, ‘The Relations between the History and the Philosophy of Science’ in *Philosophy, Science, and History: A Guide and Reader*, ed. Lydia Patton (New York: Routledge, 2014), pp. 95-105 (p. 97).

[93] Basil Mahon, *The Man Who Changed Everything: The Life of James Clerk Maxwell* (Chichester: John Wiley & Sons, 2003), p. 123.

disciplinary specificity. I thus follow Alaimo's suggestion that interdisciplinary research "requires approaches to science that neither revere it as an unproblematic path to the truth of nature, nor subject it to an echo chamber of skeptical critique."[94]

The resurgence of formalism in literary theory—in part, a reaction to the emergence of New Historicism in the 1980s—is the second critical turn with which this thesis engages. Instead of viewing history as linear and progressive, defined by demarcated eras that provide a factual background to texts, New Historicism suggests that texts are generated from a complex interplay of socio-political, cultural and economic forces. Influenced by the post-structuralist critiques of Michel Foucault, New Historicism is concerned with "finding the creative power that shapes literary works *outside* the narrow boundaries in which it had hitherto been located [emphasis original]". [95] These "narrow boundaries" constitute authorial intention and, by extension, the interpretative capacity of the critic. In its destabilisation of intentionality, New Historicism seeks to trace the extra-textual forces that contribute to a text's historical production.

English scholar Verena Theile describes how New Historicism impacted her critical approach to literature: "I felt in flux and as though literary theory was running away with me, carrying me toward history and culture but away from what I felt comfortable with: the text."[96] By the mid-2000s, New Historicism had shifted areas of literary theory away from a consideration of the text as text, to a concern with structures of influence: from aesthetics to politics, form to history, intertextuality to contextuality, cross-textual to cross-cultural inquiry.[97] But form, Theile argues, is something to be savoured. Meter, rhyme, imagery, metonym and metaphor—these are qualities whose value lies not simply in their reflection "of a culture's creative

[94] Alaimo, 'Ecology', p. 109.
[95] Catherine Gallagher and Stephen Greenblatt, *Practicing New Historicism* (Chicago and London: The University of Chicago Press, 2000), p. 12.
[96] Verena Theile, 'New Formalism(s): A Prologue' in *New Formalisms and Literary Theory*, eds. Verena Theile and Linda Tredennick (New York: Palgrave Macmillan, 2013), pp. 3-29 (p. 5).
[97] Ibid., , p. 6.

imagination" but in their ability to make reading a *pleasurable* activity.[98] Of course, Theile writes:

> A text does not live sealed off from the historical, cultural, political moments in which it participated; it does not exist in isolation. Literature actively transforms formal features it individualizes as well as historicizes. New Historicism, even as its methodology is based on interdisciplinary investigations, does not suffice. ... [It] silences literature–literature as an art form, that is, something purposefully and deliberately designed by an author.[99]

This thesis does at times engage with New Historicist methodologies, especially in its destabilisation of authorial control and focus on the forces shaping thought outside phenomenological confines. Yet ultimately, all of the arguments herein are predicated on the text: its language, syntax, imagery, metaphors, its structure and arrangement, and the ways in which it shifts, mutates and evolves through time.

In providing a brief overview of current interdisciplinary research, I aim to show how this thesis engages with important works exploring the interactions between Victorian science, literature and matter. However, this thesis also aims to build on these studies in new and original ways. One of the contributions I hope to make is to shift analyses of Victorian matter and materialism away from the tendency to 'over-empiricise'. This is not to detract from the widespread influence of empiricism and its place in nineteenth-century culture. But in presenting the non-empirical, speculative and imaginative aspects of Victorian thought, it attempts to demonstrate how the distinctions between literature and science, subject and object, reason and the absurd, body and mind, were incredibly fluid. A second contribution I hope to make is to reframe the production of ideas as inherently intensive. By arguing that intensive matter forced an inversion of the Cartesian model, emergent materialist Victorian thought is considered as both a human response to an ontological problem *and* as the encroachment of morphogenetic, nonhuman forces into the world of sense. Indeed, as

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[98] Ibid., p. 5.
[99] Ibid., p. 7.

much as success, failure—the inability of humans to impose order onto matter, contradictions within systems of thought and the ethically dubious, sometimes violent reactions to matter's dynamism—is an equally important aspect of nineteenth-century intensive materialism. While Victorians at times entered into harmonious relationships with their material environment, often they were unable to find equilibrium.

My intensive materialist story begins by considering John Tyndall's Presidential Address to the BAAS in 1874. In its strident endorsement of scientific materialism, Tyndall's lecture sent shockwaves through intellectual and public life. Chapter One argues that the materialism Tyndall outlined was misunderstood by his contemporaries and has prompted a variety of interpretations by modern critics because it was predicated on an intensive view of matter. His appeal to romantic sensibilities has led critics such as Ruth Barton to argue that Tyndall was not really a materialist. For Barton, he was a pantheist and materialism was for Tyndall only "a methodology, a program, … a maxim of scientific research, but not … a general philosophy."[100] Contrary to Barton, the chapter relocates Tyndall's thought as thoroughly material. However, instead of focussing on the Address in isolation, I approach its ideas by considering their development in Tyndall's experiences as a scientist and explorer in the Alps. Tyndall was a pioneering mountaineer and the Alps affected him in profound ways. His intensive materialism was, I argue, partially derived from a radical, combative and experimental form of embodied thinking that sought the abstraction of experience from phenomenological normality.

Thermodynamic conservation and entropy are the focus of Chapters Two and Three. In 1852, William Thomson's paper sketching an apocalyptic vision of the earth's destruction introduced heat death to the public. The concept quickly became enmeshed with wider concerns about waste, decay and dissipation, and threatened humans' ability to control their own material and spiritual destinies. Chapter Two is primarily concerned with the elaborate thermodynamic (mis)constructions of Tyndall, Stewart

[100] Ruth Barton, 'John Tyndall, Pantheist: A Rereading of the Belfast Address', *Osiris*, 3 (1987), 111-34 (p. 134).

and Tait. Entropy, for different reasons, threatened these men. In trying to reconcile the inevitability of heat death, all used speculative analogies to create pseudoscientific fantasies of eternal equilibrium. In Stewart and Tait's *The Unseen Universe* (1874), thermodynamic conservation is transformed into a principle of spiritual salvation; in Tyndall's *Heat as a Mode of Motion* (1863), the universe's invariable final state provides humans with an everlasting store of energy. But the chapter also argues that thermodynamic processes became bound up with the analogical constructs used to describe them. In transforming information across comparative terms, the analogies of these texts 'degraded' scientific laws by turning them into fanciful fictions. Thus, Chapter Two is about thermodynamic failure: the conceptual 'wastefulness' of spurious analogies and the inability of scientists to twist material reality into believable utopian fantasies.

In Chapter Three, I argue that Maxwell approached thermodynamics—and scientific laws in general—very differently. For Maxwell, analogies could combine different ideas to create new information in excess of their constituent terms. Indeed, poetry and science could together provide a fuller picture of reality. Throughout, I demonstrate how Maxwell's work is indebted to John Milton's *Paradise Lost*. Critics have all but ignored Maxwell's frequent exploration of scientific problems through Milton's poems—most notably, determinism, free will and chaos. Considering the creation of meaning from noise and the degradation of meaning from order in one of his early poems, I thus show that Maxwell adumbrated the connection between information and entropy. The chapter proceeds to show how his analogies were incredible theoretical models that practiced a form of conceptual 'black-boxing' and by conjoining different ideas, created negentropic pockets of information from open, 'noisy' systems.

The paradoxes of disjunctive love are explored in Chapter Four. Reading Robert Browning's 'Two in the Campagna' alongside other works composed during his 'middle period', it argues the poem represents one of the foremost examples of Browning's intensive realism. Nineteenth-century critics predominantly viewed Browning as an idealist who sought through poetry to attain transcendence *in spite* of the material world's grotesquery. While modern critics have complicated this construction, I demonstrate how Browning's poetry operates on the liminal threshold between the material and ideal, finite and infinite, space and time. For Browning, matter simultaneously creates and destroys the ideal. How the realist poet embodies this tension in poetry, how s/he 'puts the infinite in the finite' without reducing its complexity, is a paradox without a clear resolution. More than any other emotional experience, love—as felt in the body, as constructed collaboratively through time and as ineffable ideal—exposes the capabilities and weaknesses of thought. It forces Browning and his poetic personas to confront their inadequacies as they wrestle with the inability to understand, hold and unite with another's world. Moreover, the chapter argues that by showing how human love partially emerges from the promiscuous energies of nonhuman organic life, Browning concretises latent evolutionary anxieties that were beginning to enter the cultural consciousness in the early 1850s.

The final chapter considers *fin de siècle* representations of the unsettling relationships between people, objects and time. Frederic Harrison and Henry James are both concerned with how actions in the present can desecrate the past and how actions in the past can haunt the present. In their texts, the boundary separating subjects and objects becomes increasingly blurred as both begin to exert possessive, even violent control over others. While Harrison and James appreciated that 'things' were not just extended material bodies but had intensive histories, their texts are unable to find an equitable balance of power between owner and owned. Indeed, marked by absences, blanks and scars, their works show the violent effect nonhuman and human things have on the past: how inheritance, acquisition and possession are ambivalent, even ethically fraught processes. Ending on a melancholy note, the chapter claims that by the turn of the century, Victorians were unable to find a sustainable equilibrium with their material surroundings. After decades of incertitude, the morphogenetic, strange and unsettling capacities of intensive matter had permanently destabilised ontology and epistemology.

Materialism for non-materialists

Regardless of their religious beliefs or lack thereof, the scientists, writers and commentators discussed in this thesis all contribute to the broad turn I term intensive materialism. To be clear, this is not to underestimate or redefine through equivocation the intensely different and at times directly oppositional ideas under consideration. Nor is it to suggest that those who engaged in intensive materialist practices were materialists. As I discuss in Chapter Three, Maxwell believed that material reality was ontologically intensive and engaged in intensive thinking in his scientific, poetic and everyday life. But he was also an evangelical Christian who unerringly believed that "the presence of God is the only guarantee for true self-knowledge."[101]

I emphasise this point in order to dismantle any lingering impressions that nineteenth-century intensive materialism was opposed to metaphysics and that science and religion were locked in a struggle over intellectual superiority. Many Victorians promulgated these false dichotomies but it was possible for a Christian to use materialistic modes of thought, just as it was also possible for a self-proclaimed materialist to indulge religious sensibilities. I hope the epistemological and ontological divergences that differentiate intensive materialism from previous and future ways of viewing the world—the qualities that mark it as being uniquely Victorian—will become clear across the pages of this thesis. But as a closing remark, it would be difficult to find a better description of the adventurous energies at the heart of intensive materialism than these words written by Tyndall:

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[101] James Clerk Maxwell as quoted in Lewis Campbell and William Garnett, *The Life of James Clerk Maxwell: with a selection from his correspondence and occasional writings and a sketch of his contributions to science* (London: Macmillan and Co., 1882), p. 301.

> [T]o pass from the world of senses to a world where vision becomes spiritual, where principles are elaborated, and from which the explorer emerges with conceptions and conclusions, to be approved or rejected as they coincide, or refuse to coincide, with sensible things.[102]

In this spirit of exploration, we join Tyndall as he delves into the mysterious realm of the scientific imagination and pushes his body to its physical limits. Laboratories and lecture halls had their place. But for Tyndall, the most exciting new science was produced outside the institution and in the laboratories of Nature—the glaciers, rocks, caverns and peaks of the Alpine wilderness.

[102] John Tyndall, *Heat Considered as a Mode of Motion* (Cambridge: Cambridge University Press, 2014), p. vii.

CHAPTER ONE

John Tyndall, intensive materialist: embodied Alpine encounters and the limits of the scientific imagination

Introduction: Belfast, 1874

Two months before he was due to deliver his inaugural Presidential Address before the British Association for the Advancement of Science (BAAS), John Tyndall received a letter of caution from his biologist friend and fellow supporter of scientific naturalism, T. H. Huxley:

> I wonder if that Address is begun, and if you are going to be as wise and prudent as I was at Liverpool. When I think of the temptation I resisted on that occasion, … "I marvel at my own forbearance!"[1]

It seems Huxley sensed a storm brewing over the horizon. He was, of course, familiar with the portents.

His legendary Oxford debate with Bishop Samuel Wilberforce in June 1860 had established Huxley as one of Britain's foremost scientific naturalists and a master polemicist. Aiming to personalise the argument, Wilberforce asked which side of Huxley's family had descended from apes—his mother's or his father's. Huxley proved he could punch lower and harder. It was no shame, he replied, to have risen from primitive ancestry. But, he added, over the noise of the raucous crowd packed into the Oxford University Museum, it would be immensely humiliating "to have sprung from

[1] T. H. Huxley, letter to John Tyndall, 24th June 1874. This letter was obtained from the archives of the Royal Institution of Great Britain. *Tyndall Correspondences*, *Vol. 9*, 2800–3181. JT/1/TYP/9, 3034–35.

one who prostituted the gifts of culture and eloquence to the service of prejudice and falsehood."[2] The press responded accordingly. "Scientist would rather be related to ape than bishop", read the week's headlines.[3] Thereafter, Huxley would be known as "Darwin's Bulldog". And not content in limiting caricatures of him to the canine species, *Punch* would later depict him as a "Piscequestrian" while *The Times* newspaper, as Tyndall helpfully reminded his friend, regarded him as a "wild bull".[4]

Huxley was therefore well placed to advise Tyndall on the repercussions of strident discourse. Even so, his cautionary urge for discretion seems surprising given both his and Tyndall's opposition to theological orthodoxy and their promotion of scientific materialism. What, in other words, did they stand to lose? At an institutional level, they risked being seen as rebels within the BAAS. The organisation's prestige and far-reaching impact meant that its annually elected president "spoke for science and had to represent the views of the scientific community" at large.[5] Although conflicting personal agendas encouraged diversity and debate, there was nonetheless the tacit expectation that during his term, the President would keep the community on an even keel. On a more personal level, Huxley also wanted to safeguard Tyndall's public reputation, and with it, the reputation of scientific naturalism. As Bernard Lightman notes, before the Belfast Address, "Tyndall was usually cast in a positive light in the periodical press, albeit with some reservations, and he was not labelled as a materialist."[6]

This was in spite of Tyndall's bitter public dispute with James David Forbes and John Ruskin over the glacial theory of regelation and numerous spats with the 'North British' Christian physicist Peter Guthrie Tait. Moreover, Tyndall was if anything more

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[2] As quoted in Leonard Huxley, ed. *Life and Letters of Thomas Henry Huxley*, 3 vols (Cambridge and New York: Cambridge University Press, 2012), I, p. 270.
[3] Ian Hesketh, *Of Apes and Ancestors: Evolution, Christianity, and the Oxford Debate* (Toronto and London: University of Toronto Press, 2009), p. 6.
[4] *Punch*, 80 (1881), p. 130; John Tyndall, letter to Huxley, October 1869. JT/1/TYP/9, 2927.
[5] Barton, 'Tyndall, Pantheist', p. 115.
[6] Bernard Lightman, 'Scientists as Materialists in the Periodical Press: Tyndall's Belfast Address', in *Science Serialized: Representation of the Sciences in Nineteenth-Century Periodicals*, ed. by Geoffrey Cantor and Sally Shuttleworth, (Massachusetts: Massachusetts Institute of Technology Press, 2004), pp. 199–238 (p. 202).

outspoken and rhetorically reckless than Huxley. Never one to hide his materialist inclinations, many of his publications and lectures prior to 1874 promoted atomist conceptions of physical reality alongside a growing critique of theological authority. In 1860, responding to Wilberforce's call for a national day of prayer, Tyndall proposed a simple medical trial comparing mortality rates from two separate hospital wards. One set of patients would receive ordinary medical care; the other, in addition to their treatment but without their knowledge, would be prayed for by a group of strangers over the course of several years. The 'prayer-gauge' test, as it was known, was never put into practice. Tyndall reopened the debate, however, in a letter to the July 1872 edition of *Contemporary Review*, by calling for, as his subtitle read, "a serious attempt to estimate its [prayer's] value".[7] Yet, although objections were raised, Tyndall was still held in high esteem by the general public and the majority of the periodical press. He emerged from these debates with both his integrity and perceived scientific authority intact.

All this changed in the immediate aftermath of the Address. On the 19th August 1874, Tyndall took to the podium of Belfast's Ulster Hall and standing before an audience numbering nearly three thousand delivered his lecture of an hour and three-quarters' length. Recent paradigm-shifting discoveries in modern science, he argued, provided a legitimate basis upon which to assert the moral and intellectual nobility of philosophical materialism. Beginning with the Greek atomists, he traced the efforts of these "men of exceptional power" in clearing "the world of the fantastic images of divinities operating capriciously through natural phenomena."[8] Praise for Bacon, Galileo, Gassendi and Spinoza followed. These too were thinkers who, clear of the

[7] John Tyndall, 'The "Prayer for the Sick:" Hints Towards a Serious Attempt to Estimate its Value', in *Contemporary Review*, 20 (1872), 205–10 (p. 205).

[8] John Tyndall, *Address Delivered Before The British Association Assembled at Belfast, With Additions* (London: Longmans, Green, and Co., 1874), p. 2; 11. [Longmans published this version of the Address with some minor revisions and additions immediately following the meeting at Belfast. The Address in its original form was published by some weekly and monthly publications, including *The Times* and *Nature* the following day. Slight differences exist between the editions and I compare relevant passages later in the chapter. However, unless otherwise stated, all further references will be from this version].

Middle Ages' scholarly retardation, had further repelled Christianity's inimical influence on the progress of knowledge. Tyndall's synoptic account raced through the scientific revolutions engendered by this struggle: from Aristotle's geocentric universe to Copernican heliocentrism; from divinely implanted consciousness to the electrical relays of the nervous system. Darwin's theory of evolution by natural selection and the synthesis of the laws of thermodynamics represented the pinnacle of this achievement, possessing an explanatory power far greater than any divine agent. And Occam's razor dispensed with the need for supernatural intervention; purely physical processes drove nature's laws.

Tyndall's closing thoughts were seemingly unequivocal:

> All religious theories, schemes and systems, which embrace notions of cosmogony, or which otherwise reach into the domain of science, must, *in so far as they do this,* submit to the control of science, and relinquish all thought of controlling it [emphasis original].[9]

To the shocked and excited ranks in the hall, this was surely the most strident pronouncement of materialistic impiety delivered from such a prestigious platform. Immediately, Tyndall found himself at the centre of a storm whose vehemence not even Huxley could have foreseen. "Every pulpit in Belfast thundered of me," wrote Tyndall in a letter dated 26th August to his friend Thomas Archer Hirst. "Even the Roman Catholics who are usually wise enough to let such things alone came down upon me."[10] The press were equally ferocious, traducing him as a dangerous, combative atheist who, by "straying into the murky swamps of metaphysics," had forsaken scientific truth in order to pursue his own dogmatic agenda.[11] In a damning editorial in *The Observer*, Tyndall was charged, along with the BAAS, of "furnish[ing] artificial and dangerous incentive to the manufacture of hasty and crude generalisations, flashy theories, and

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[9] Tyndall, *Address*, p. 61.
[10] John Tyndall, letter to T. A. Hirst, 26th August 1874. JT/1/T/715.
[11] Joe D. Burchfield, 'John Tyndall – A Biographical Sketch', in *John Tyndall: Essays on a Natural Philosopher*, ed. by William H. Brock, Norman D. McMillan and R. Charles Mollan (Dublin: Royal Dublin Society, 1981), 1–13 (p. 7).

specious cosmogonies."[12] And while pages of print were devoted to repudiating his materialism, scandalised whispers filled the members' clubs and dining halls insinuating Tyndall was a suspicious sexual deviant who had lost his once brilliant intellect. Even his friend Thomas Carlyle, whose 'natural supernaturalism' provided Tyndall with metaphysical inspiration, was said to have despised the Address. "[A] philosophy for dogs," were his reported words.[13]

Nonetheless, the materialism outlined in Tyndall's Address was carefully qualified. He went to great lengths to distinguish his position from the "very rank" philosophy of Democritus and stressed the limitations of materialism as an exhaustive theory of reality.[14] Although Tyndall sought to delimit religious narratives from the methodical rigours of scientific investigation, he still acknowledged that "deep-set feeling[s]" of the numinous and transcendental are inextricably "woven into the texture of man".[15] To deny these sentiments—sentiments that separate the human from baser life forms—is to ignore the "ancient" and powerful "passion" constituting the "antecedent to all relative experience whatever".[16]

Whether by ignorance or choice, these caveats and the delineation of 'superior' materialism from deterministic theories of simple 'matter in motion' were almost entirely ignored by Tyndall's critics. Even so, these critics were not united in condemnation of the Address; nor were their criticisms in relative accord. That Tyndall sought to introduce into British intellectual life paganism, atheism, lower-class radicalism, sexual deviancy, animalism and Eastern mysticism, were among the many allegations flung his way. The variety of responses to the Address is telling—as if those hostile to it were convinced of its general offensiveness but unsure of the specifics.

This is one of the concerns of this chapter, which re-examines the 'higher' materialism espoused in both the Address and Tyndall's other writings, alongside a

[12] Editorial article–no title. *The Observer*, 23rd August 1874, p. 4.
[13] H. A. Hammond, letter to John Tyndall, 5th February, 1875. MS JT/1/H/27.
[14] Tyndall, *Address*, p. 58.
[15] Ibid., p. 60.
[16] Ibid.

critical re-evaluation of the anger it provoked. It was a philosophy at once old and radically new, elastic and dialectic, but never entirely reductionist, deterministic or easy to categorise. It appealed to pantheism, natural supernaturalism and idealism but was never defined solely by any one of these things. In fact, not even Huxley properly grasped the eccentricity of Tyndall's materialism. A stable, neatly packaged philosophy free of contradictions and flaws it was not. Rather, Tyndall's scientific materialism constituted a radical response to the newly glimpsed heterogeneous vitality of matter: a world of minuscule, sub-microscopic particles, mysterious forces, intense and intensive speeds, pressures and temperatures which was being uncovered, discovered and created by nineteenth-century science. These qualities course through Tyndall's texts but are restricted by language that is unstable and reliant upon past modes of thought for its articulation. Indeed, because, as Tyndall claimed, "[s]cientific theories sometimes float like rumours in the air before they receive definite expression", he had to find ways of gathering these nebulous, incipient concepts and arranging them into coherent blocks of knowledge.[17]

For Tyndall, this energetic philosophy was thus more than an abstract concept. Theoretical, for sure, but embodied and creative too, and written into existence as much as constructed from previous materialist conceptions. Tyndall's passion for mountaineering was bound up in this process. He thought not only with his intellect but with and through his body too, interacting corporeally with the ephemeral and "unseen things of nature".[18] The confused and contradictory critical responses to Tyndall's work, both of the time and now, result from this inherent messiness. Whereas a number of modern critics of Tyndall have shied away from the term 'materialism', this chapter embraces it. Delving into the absurdities of Tyndall's synthesis of linguistic and embodied thought, this chapter sketches a philosophy that was imaginative and radical but *also* disordered and inchoate. It was these very qualities that made so many

[17] Tyndall, 'Science and Man', *Fortnightly Review*, 22 (1865), 593-617 (p. 596).
[18] John Tyndall, 'On the Scientific Use of the Imagination: a discourse delivered before the British Association at Liverpool, 16th September, 1870', in *Scientific Use of the Imagination and Other Essays* (London: Longmans, Green, and Co., 1872), 1–38 (p. 5).

critics of the time react with disgust and fear. This was indeed materialism. But as Tyndall told his Belfast audience, it is "'materialism' … vastly different from what you suppose".[19]

1.1 Critical conflicts

Although 1870s Britain was in a state of upheaval, characterised by what Owen Chadwick has referred to as the secularisation of the European mind, any narrative in which science and religion are pitted as ideological antagonists is too simple to account for the numerous contradictions of the period.[20] Nonetheless, historians of science have, until recently, been content to ignore the inherent complexities of both the Address and responses to it, framing it as *the* iconoclastic clash in the 'war' between Victorian science and religion. For the nineteenth-century historian Andrew White, Tyndall's Address constituted another violent chapter in the "long and terrible war" waged between the powers of science and theology.[21] Modern historian of science Frank Turner, meanwhile, also adopts the conflict thesis in *Between Science and Religion* (1974) and 'The Victorian Conflict between Science and Religion' (1977). According to Turner, a group of "crusading scientists", including Tyndall and Huxley, dogmatically defined the intellectual limits of Victorian Britain by promoting naturalism as the only source of knowledge.[22] Two interrelated goals drove the naturalists' agenda. First, Tyndall and his colleagues sought institutional tenure, social prestige and control of research funds by distinguishing their professional expertise from the work of amateur scientific practitioners. Second, they sought to secularise society by advancing "a completely naturalistic view of nature" from which all "religious purposes and

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[19] Tyndall, *Address*, p. 56.
[20] See Owen Chadwick, *The Secularization of the European Mind in the 19th Century* (Cambridge: Cambridge University Press, 1975).
[21] Andrew Dickson White, *The Warfare of Science* (New York: D. Appleton and Co., 1876), p. 70. Tyndall evidently bought into this reductionist conflict hypothesis, providing a preface to the British edition of White's book.
[22] Frank M. Turner, 'The Victorian Conflict between Science and Religion: A Professional Dimension', *Isis*, 69 (1978), 356-76 (p. 364).

categories" were banished.[23] For the 'naturalistic publicists' science held little value beyond its capacity to leverage social discourse: "[s]ecularization was their goal; science, their weapon."[24]

Although the growth of nineteenth-century British science is inseparable from these various struggles for authority, Turner's argument is reductive. Indulging in speculation for a moment, had Tyndall sought the highest professional platform from which to deploy science as a weapon, it seems probable he would have readily accepted the presidency of the BAAS upon its initial offer. His private correspondences tell a different story: "I wish to high Heaven you had not persuaded me to accept that Belfast duty," Tyndall wrote to Huxley on 24th September, 1873.[25] A month later he reiterated this reluctance in a letter to Hermann von Helmholtz: "[I accepted the position] [m]uch against my will and simply to avoid offending the Council, whose invitation I had already declined three times."[26] While these letters say little on their own, they do complicate Turner's picture of a man determined to use his authority to incite a cultural war.

Moreover, Tyndall in fact went to great lengths in his Address to affirm his conviction that science "derives motive power from an ultra-scientific source" and is only an approximate rendering of a material "[p]ower absolutely inscrutable to the intellect of man."[27] Indeed, religious sentiment was never the target of his ire but rather indolent theological speculation. For Tyndall, "the love of the beautiful, physical, and moral, in Nature, Poetry, and Art," furnishes and is furnished by the scientific intellect. Thus, "[t]ruth is often of a dual character," to be glimpsed in the conjunction of the scientific and the aesthetic, the physical and the numinous.[28]As George Levine argues,

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[23] Ibid., p. 365.
[24] Frank M. Turner, *Between Science and Religion: Reaction to Scientific Naturalism in Late Victorian England* (New Haven: Yale University Press, 1974), p. 16.
[25] As quoted in Lightman, 'Scientists as Materialists', p. 199.
[26] John Tyndall, letter to Hermann von Helmholtz, 26th October 1873. JT/1/T/491.
[27] Tyndall, *Address*, pp. 61; 57–58.
[28] John Tyndall, 'Scope and Limit of Scientific Materialism: An Address Delivered in the Mathematical and Physical Section of the British Association in Norwich, 19th August, 1868', in *Scientific Use of the Imagination and Other Essays*, 39–54 (p. 44).

"no thinkers were *more* aware of the difficulties of objectivity or of the various ways in which knowledge is filtered through particular consciousness [emphasis original]."[29] Given these concessions, Turner's argument must be taken with a grain of scepticism. Indeed, a great number of Victorians, regardless of their private beliefs, were commonly inspired, astonished, baffled and disturbed by the dynamic complexity of the new science of matter and energy. Hence, an overarching framework construing religion and science as antithetical is otiose.

A growing body of recent criticism has further challenged the prevalent caricature of Tyndall as "impatiently reject[ing] any partnership between science and religion".[30] Alongside re-establishing Tyndall's influence in defining physics as a distinct science, critics have interrogated his materialism by relocating it among the cultural and philosophical precepts being circulated and produced by nineteenth-century culture at large. Although in broad agreement that he was not a vulgar or deterministic materialist, critics have thus variously considered Tyndall as a transcendentalist (Stephen Kim), agnostic (Lightman), and a pantheist (Ruth Barton).[31] My argument is indebted to these analyses yet strives to reaffirm the materiality of Tyndall's thought tracing both its *dualistic* (or entangled, harmonious and unified) and *duelistic* (estranged, oppositional and combative) interactions between body, language, thought and matter. Moreover, most of these works have been written from a historical perspective. But whereas Lightman and others locate Tyndall *within* shifting social, intellectual, cultural and political networks, I destabilise this construction by showing how Tyndall's materialism is both within *and* without these larger paradigms, both of its time and yet not of its time.

Tyndall's materialism thus maintains a paradoxical relationship to temporal stability and contextual orientation. Enmeshed in the fabric of contemporary Victorian

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[29] George Levine, *Realism, Ethics and Secularism: Essays on Victorian Literature and Science* (Cambridge: Cambridge University Press, 2008), pp. 105–06.
[30] Martha A. Turner, *Mechanism and the Novel: Science in the Narrative Process* (Cambridge: Cambridge University Press, 1993), p. 28.
[31] Stephen S. Kim, J*ohn Tyndall's Transcendental Materialism and the Conflict Between Science and Religion in Victorian England*, (Lewiston, NY: Mellen University Press, 1996)

thought, it is simultaneously anachronistic, in its indebtedness to Greek atomism and Romantic idealism, and adumbrative, in prefiguring concepts which would not be expressed fully until well into the twentieth century. Attempts to reintroduce such inconsistencies back into a historically logical framework are undercut by their contradictory nature. They do not quite fit. Which is partly why Tyndall offers such rich interpretive potential and why past and present critics have offered such varied accounts of his materialism, with no single one (including this chapter's, of course) being definitive.

The second departure I make is to reframe the discussion as a problem of *matter* rather than a problem of *materialism*. More than semantic quibbling, this concerns a shift in ontological perspective that can be rephrased in question form: *What does Tyndall think about matter?* (a question that is nonetheless addressed) becomes, *why does matter provoke Tyndall to think this way?* The difference here is one of direction. The material world imposes itself upon the individual and fashioning these raw encounters into mathematical, linguistic, experimental and bodily expressions is synonymous, for Tyndall, with living a challenging and ethical life. Tyndall often spoke of the necessary fusion between body and soul, between emotion and intellect, and how the two are brought together by penetrating the "penumbral region which surrounds actual knowledge".[32] Yet little has been made of how this practice enfolds both human and nonhuman participants—glaciers, rocks, ice picks, clouds—to create a wild, *intensive* materialism. This is a materialism that reflects not the static, deterministic, rational matter of old, but the energetic, incorporeal and irrational matter of Victorian Britain: the matter of steam, heat, speed and thought, deep time, miniscule atoms and massive, dying suns.

As we have seen, Tyndall's description of this materialism seemed to confound his critics, who were unable to fix its strange nuances within the limits of expectation. "The Belfast Address has brought down upon me a perfect avalanche of abuse", he

[32] Tyndall, 'Scientific Materialism', p. 43.

complained to an acquaintance.[33] One gets the impression that the sudden deluge of frosty indignation rather caught him by surprise—as if, perhaps rather arrogantly, he felt the force of his argument too persuasive to deny. But another uneasy chill permeates the phrase. Like so many of Tyndall's metaphors this is not just an idle expression; it has a rhetorical energy of its own. Because Tyndall already had first-hand experience of what it was like to be caught, quite literally, in a sudden and overwhelming landslide.

1.2 Tyndall among the Alps

The Paratethys sea, sixty-five million years ago or thereabouts: and change is afoot.[34]

Immense orogenic processes are forcing the African and Eurasian tectonic plates together in a gargantuan collision. For hundreds of millions of years, limestone, sand and clay has been deposited as sediment on the sea floor. Now, caught between the enormous stresses generated by the drifting continents, it buckles and writhes, convulsing vertically into great recumbent folds. Billions of tonnes of stratified matter thrust skywards, rising thousands of feet out of the earth's fragile crust: the contorted rocks of the Alps. This geomorphic process spans millions of years and continues unabated. Eons later the vast Alpine body continues to grow as tectonic subduction forces it into new, layered folds. And yet, all the while it fissures and crumbles as wind and rain erode its faces and glacial ice carves deep gouges in its sides.[35] Both ancient and new, the mountainous body thus represents "a flow whose timescale is nearly unfathomable from the scale of duration represented by the electrolytic and metabolic

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[33] John Tyndall, letter to Rudolf Clausius, 16th June 1875. MS JT/1/T/207.

[34] Modern geologists generally agree that the emergence of the Alps from the sea, formed as the African plate travelled northwards colliding with the Eurasian plate, occurred at around the same time as the Cretaceous-Tertiary Extinction: roughly sixty-five million years ago.

[35] Andrew Beattie, *The Alps: A Cultural History* (Oxford: Oxford University Press, 2006), pp. 8-9.

processes" of biological bodies.[36] Nearly unfathomable, but not entirely. Occasionally geological and human time converges. Occasionally a split second and the twitch of a muscle is all it takes to move mountains. Fast-forward millions of years to mid-afternoon on the 30th July 1864, to a medium-sized Alp in Switzerland's Bernina Range. An avalanche is surging down the mountain's eastern face. And five men are plummeting with it.

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It had taken Tyndall, a pair of Englishmen and two local guides, a little over eight hours to reach the summit of the Piz Morteratsch. Dazzling midday sunlight warmed the group as they rested on the peak; Tyndall observed the shifting aerosolic complexity of the clouds below; a bottle of champagne was uncorked and drunk too. But on their way down the mountainside the group encountered a vertiginous slope of ice, which in spite of Tyndall's reluctance, lead guide Jenni decided to tackle. Bound together by a hemp rope, the men inched along the ice; a precipitous chasm loomed below. A false step, then a rush of snow. Suddenly, in "the twinkling of an eye", the five men were hurled downwards "with uncontrollable speed on the back of an avalanche".[37] They tumbled for over a thousand feet. Miraculously the men emerged from this near-death experience with no more than cuts, bruises and welts. The most severe injury sustained was the parting of Tyndall's pocket watch from its chain, itself astonishingly recovered from the scene of the accident eighteen days later. But in this moment, each man was changed; they had experienced the awesome unpredictability of nature. It had taken the group eight hours to reach the mountain's summit. Only a few seconds were needed to bring them tumbling back down.

Implied by this difference between comparative scales—from the group's steady upward trek to their rapid decent—is a similar gulf, yet one that is almost impossible to grasp. By contracting and relaxing muscles, by becoming alternatively firm and elastic,

[36] Sanford Kwinter, *Architectures of Time: Toward a Theory of the Event in Modernist Culture* (Cambridge, MA: Massachusetts Institute of Technology, 2001), p. 31.
[37] John Tyndall, *Hours of Exercise in the Alps* (London: Longmans, Green, and Co., 1871), p. 212.

the climber alters the vertical trajectory of her or his body. By compression and intrusion, metamorphism through states of hardness and softness, rock is thrust skyward. Each of these processes has its own spatiotemporal scale, separated by gargantuan units of measurement, hours to eons, centimetres to miles. But in climbing, these immensely different scales become entangled. Through an appreciation of the energetic forces acting within and upon the human body, a greater understanding of the power of inorganic matter is glimpsed. It is from the interactions between corporeal forms—human, plant, animal, mountain—from both their contiguity *and* their disharmony, that Tyndall finds an intensive appreciation of matter. Hence an event as extraordinary and terrifying as being caught in an avalanche has for Tyndall instrumental, illustrative, thought-provoking potential. Bodily *entanglement* and *estrangement*: these two oppositional yet intertwined concepts constitute the bedrock of Tyndall's lived materialism and its subsequent expression in language. Before unpacking these ideas, however, we must trace how this unique materialism blossomed in the Alpine landscape. It began in earnest when, after his first visit to the mountains in 1849, Tyndall discovered a laboratory site equipped with far greater experimental resources than any human-made research centre.

Tyndall's Alpine adventures were well documented. *The Glaciers of the Alps* (1860) and later *Hours of Exercise in the Alps* (1871) combined travel memoir, adventure story and scientific treatise to tap into the Victorian public's fascination with both mountaineering tales and popular scientific exposition. It speaks to the current critical obsession with the Belfast Address, however, that such a major part of Tyndall's personal and scientific life has, until recently, been under-explored. Michael S. Reidy addresses this scholarly gap in his article 'John Tyndall's Vertical Physics: From Rock Quarries to Icy Peaks' (2010).[38] Reidy reframes Tyndall's mountaineering adventures as inextricable from the physicist's science. Indeed, the missing watch owed its recovery

[38] Michael S. Reidy, 'John Tyndall's Vertical Physics: From Rock Quarries to Icy Peaks' in *Physics in Perspective*, 12 (2010), 122–45.

to a combination of mountaineering knowledge and scientific intuition.[39] More than this however:

> Tyndall's attention to the vertical realm also significantly changed the scope, method, and direction of his science. Tyndall's science brought him to the mountains, but the mountains themselves further determined the approach he followed in his researches.[40]

According to Reidy, the Alps were for Tyndall a "vertical laboratory of Nature" replete with grand and diverse experimental possibilities on a scale inconceivable in an institutional environment.[41] Indeed, Tyndall's work was radically shaped by the very experience of climbing: of realising that matter and fundamental natural forces could be observed differently, even behaved differently, relative to their height and elevation.

In 1859, Tyndall scaled Mont Blanc and set up five observation stations along the route.[42] The experiments carried out at these posts measured the everyday yet elusive "physical processes which correspond to our sensations."[43] It is around this time that Reidy identifies verticality beginning to influence Tyndall's science. Indeed, Tyndall's increasing reliance upon comparative "observations made at different heights" led to some radical new discoveries.[44] In 1859 Tyndall verified that atmospheric gases—specifically, carbon dioxide, water vapour, methane and ozone—contributed to the retention of solar heat in the earth's atmosphere by absorbing infrared radiation: a phenomenon later termed the 'greenhouse effect'.[45] Further investigations revealed how light is polarised by gaseous matter (in other words, why the sky is blue). Other discoveries or confirmation of previous theories also came about

[39] Ibid., p. 123.
[40] Ibid., p. 140.
[41] Ibid., p. 123.
[42] A small correction must be made to Reidy's chronology. Reidy states that Tyndall set up the observation stations in 1857, the year he first climbed Mont Blanc. In fact: "[t]he thermometers ... were placed on Mont Blanc in 1859" with the "countenance and aid" of the Royal Society. *Hours*, pp. 53–58 (p. 53).
[43] Tyndall, 'Scientific Use', p. 8.
[44] Reidy, 'Vertical', p. 131.
[45] Tyndall, 'On Radiation Through the Earth's Atmosphere' in *Contributions to Molecular Physics in the Domain of Radiant Heat* (London: Longman, Greens and Co., 1872) pp. 421-424.

by happenstance. In an 1858 letter to Lady Juliet Pollock, Tyndall made the following remarks regarding an impromptu experiment conducted high on the Finsteraarhorn: “The boiling point of water is 25 degrees lower than at the sea level, which explains the fact of my having poured a quantity of boiling water over my guide’s hand without scalding him.”[46] Whether the valiant guide willingly offered his hand in the furtherance of scientific research is left open to speculation.

The immense scale of the Alps allowed Tyndall to observe processes taking place over spatiotemporal scales that would be impossible to reproduce in a controlled laboratory. Tyndall was convinced, for example that glacial motion was characteristic of the phenomenon termed *regelation*: the theory that glacial ice does not flow like a viscous liquid but rather fissures, melts and refreezes under pressure, effectively squeezing the lower portion of the glacier out from under its upper regions. Among the scientific community, the idea was controversial and embroiled Tyndall in a bitter public dispute with James David Forbes and John Ruskin that spanned decades. But while small-scale experiments in support of both regelation and flow theories proved inconclusive on their own (Tyndall used wax and dough, Ruskin treacle and piecrust), for Tyndall, actual glaciers could reveal the truth.[47]

Writing in 1858, Tyndall proposed that the veined structure of the Lower Grindelwald glacier viewed from multiple vantage points provided irrefutable evidence in support of regelation:

> I … examined the fall from the opposite side of the valley, and corroborated the observations. It is difficult, in words, to convey the force of the evidence which this glacier presents to the observer who sees it; it seems in fact like a grand laboratory experiment made by Nature herself.[48]

[46] Tyndall, letter to Lady Juliet Pollock, 4th August 1858. *Tyndall Correspondences Vol. 6*, JT/1/TYP/6.
[47] Paul L. Sawyer, ‘Ruskin and Tyndall: The Poetry of Matter and the Poetry of Spirit’ in *Annals of the New York Academy of Sciences*, 360 (1981), 217–46 (p. 220).
[48] Tyndall, *Hours*, p. 370.

Tyndall was fond of impressing upon his readers the empirical authenticity of his research and the perceptual advantage gained from working directly in the "laboratories of nature".[49] Here, the information gathered by his eyes is so compelling that language is unable to convey its "force". This idea concerning the (non)transferral or transmutation of energy into and through language along with the potential for matter to forcefully disrupt articulation is returned to later. Even so, what appears initially to be an appeal to the authority of data is qualified by Tyndall's claim that "good observers frequently prove but indifferent experimenters."[50] On its own, evidence derived from observation is little more than disordered information. Being, "for the most part, inadequate and inconclusive", it demands to be interpreted.[51] If this argument is considered solely in these terms, then proper scientific insight thus constitutes a synthesis between observation, experimentation and cross-examination. Nature, as Tyndall writes, must be put "in the witness-box".[52]

Yet Tyndall's claim to having *seen* the evidence with his own eyes also plays on his ability to *climb* the Alps—a prowess few others could match. He argues therefore from a position of experiential authority, taunting scientists whom he sees as less *in touch* with the material world. While Reidy's thesis that Tyndall's "fascination with mountaineering" was inextricable from his scientific experiments is correct, it thus also leaves some tantalising insights unexplored.[53] In fact, 'verticality' implies more than a simple shift in perspective. The term encompasses adjacent notions of embeddedness, (op)position, difference, scale and directionality. Perhaps most resonantly, verticality also connotes extremes: things at the opposite end of the spectrum from one another, such as extremes between states of immense physical exertion and sublime, almost transcendental relaxation and reflection. Furthermore, Reidy does not satisfactorily consider how these notions of verticality begin to become entangled with Tyndall's

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49 Tyndall, 'Scientific Use', p. 29.
50 Tyndall, *New Fragments* (New York: D. Appleton and Company, 1892), p. 399.
51 Ibid., p. 399.
52 Ibid., p. 213.
53 Reidy, 'Vertical', p. 131.

language. Indeed the scientific, even ethical superiority Tyndall sees in muscular exertion, and the experiential qualities of climbing furnished him with a set of charged metaphorical associations that could be used to describe the accumulation of knowledge, intellectual achievement and the power of the body. While Reidy briefly refers to these metaphors—"the hardest climb, by far," Tyndall declared when retiring from the Royal Institution in 1887, "was from the banks of the Barrow to the banks of the Thames"—he does not consider the problems inherent to the metaphorical transformation of verticality.[54]

Tyndall's climbing metaphors are used to describe more than his own personal achievement. His mentor at the Royal Institution, Michael Faraday, is conceived as a scientific 'discoverer' who, like "the climber jubilant on the mountain top", surveys the intellectual ground he has scaled.[55] The effort required to reach these heights is often, Tyndall claims, overlooked: "[t]he world knows little of the toil of the discoverer."[56] To reach this position, "[p]robably hundreds of experiments have been made". Indeed, "the dominant result does not stand alone, but forms the culminating point of a vast and varied mass of inquiry."[57] Invariably, scientific discovery is presented as a heroic and singular activity rather than a collaborative process. As a metaphorical motif, Tyndall's friend and philosophical hero Thomas Carlyle had already sketched a portrait of the brave intellectual explorer "climbing the giddy Alpine heights of Science" in *Sartor Resartus*.[58] But Tyndall's appropriation of the metaphor has greater rhetorical resonance because he speaks from a position of experiential authority. Perhaps it is all the more problematic, then, that Tyndall elides the interactive, interdependent and collective aspects of both science *and* mountaineering. Though Tyndall did practise both activities on his own, he also developed scientific ideas in conjunction with fellow

[54] Ibid., p. 142.
[55] Tyndall, *Faraday as a Discoverer* (New York: D. Appleton and Company, 1890), p. 82.
[56] Ibid.
[57] Ibid., p. 145.
[58] Thomas Carlyle, *Sartor Resartus* (New York: Frederick A. Stokes Company, 1893), p. 234.

colleagues and climbed the mountains with the help of local guides. That Tyndall's metaphors obscure this reality is indicative of a certain arrogance in his writing.

By arguing that Tyndall earned the right to clothe narratives of progress in the language of heroic idealism and vertical ascendency, Reidy fails to expose the problematic aspects of Tyndall's climbing metaphors. In fact, alongside refashioning collective discovery as a singular enterprise, Tyndall also frames scientific progress in hierarchical terms. The implicit vertical taxonomy of 'higher' and 'lower' traits is manifest in the evolutionary divergence of forms—from simple to complex, general to particular, weak to strong, common to rarefied: "none but the simplest forms of life lie lowest down," Tyndall commented in his Belfast Address: "as we climb higher among the super-imposed strata more perfect forms appear."[59] Likewise, from humble origins, Tyndall's accumulating achievements propel him out of the primordial slime and onto the banks of the Thames. In Tyndall's climbing metaphors, verticality comes to stand for both the superiority of materialist science and the triumph of the individual will.

The verticality of Tyndall's language derives in part from more general processes of metaphorical production. Modern theory suggests metaphors are first rooted in experiential, bodily and spatial knowledge. Of the various orientations possible, the most commonly understood among different cultures are relations structured along the *y*-axis. According to *Zoltán Kövecses*, the metaphorical concept of *more is up* (where 'more' corresponds to 'up' and 'less' corresponds to 'down'*)* operates through the conjunction of everyday experience and the notions of quantity and scale.[60] These commonly understood similarities are derived first from our experience of ordinary situations defined in part by vertical orientation. Filling a container and watching the level of liquid rise; the experience of standing upright; watching someone or something grow taller over time, and so on. Because this intuitive connection between scale and quantity is so ubiquitous, verticality as a metaphorical register is

[59] Tyndall, *Address*, p. 36.
[60] Zoltán Kövecses, *Metaphor: A Practical Introduction* (Oxford: Oxford University Press, 2010), p. 80.

similarly invoked in common language. For example, here is Tyndall's mountaineering companion Phillip Gossett commenting upon his 'elevation' of mood when approaching the Haut de Cry: "The peak was glistening before us, and the idea of success put us in high spirits."[61] Although somewhat hackneyed, expressions such as these rely on common notions of space figured metaphorically and metaphors figured spatially. They also form part of a wider system of embodied knowledge that prioritises the vertical over the horizontal and other, more circuitous and complex orientations in space. Hence, writes J. A Laponce, "the vertical is, par excellence, the dimension that structures and orders, that which tolerates least disturbance, that which contains most of our invariant real knowledge about spatial location."[62] Tyndall's climbing metaphors tap into this already existing conceptual prejudice. Yet although they find a natural partnership with his own experiences of verticality, Tyndall's language, as critics such as Ruskin claimed, served to promote personal vanity in place of Nature.

Alone on the peak of the Monte Rosa, Tyndall's contemplation of the mountain's strength, "apparently motionless, but suggesting motion–sluggish but indicating irresistible dynamic energy" leads him in turn to consider his own powers:

> I thought of my position: it was the first time that a man had stood alone upon that wild peak and were the imagination let loose amid the surrounding agencies, and permitted to dwell upon the perils which separated the climber from his kind, I dare say curious feelings might have been engendered. But I was prompt to quell all thoughts which might lessen my strength, or interfere with the calm appreciation of it.[63]

It is in moments like these that Tyndall embodied for Ruskin everything that is ignorant and immoral about materialism. Ruskin's claims find further support in the inherent hostility of Tyndall's language—a language that aligns him with the imperial

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[61] Gossett as quoted in Tyndall, *Hours*, p. 194.
[62] J. A. Laponce, *Left and Right: The Topography of Political Perceptions* (Toronto: University of Toronto Press, 1981), p. 70.
[63] Tyndall, *Glaciers*, p. 157.

explorer and participant in "the 'great game' of European expansion, a game undertaken by bands of British men … in the service of science as well as empire."[64]

The rhetoric of Tyndall's Alpine books thus plays into this wider notion of powerful masculine science. "Read Professor Tyndall's narrative of the last part of the ascent of the Weisshorn," remarked a review of *Hours of Exercise* in *The Spectator*, "and see if it does not breathe the very spirit of English doggedness, which *cannot* give in, which perseveres to the end".[65] The passage in question is most likely the following:

> I thought of Englishmen in battle, of the qualities which had made them famous: it was mainly the quality of not knowing when to yield – of fighting for duty even after they had ceased to be animated by hope. Such thoughts helped to lift me over the rocks.[66]

Of course, Tyndall, an Irishman, positions himself outside of the sphere of "Englishness". These characteristics are what had made others famous. Yet imagery of this kind is rife throughout Tyndall's Alpine accounts, peppered as they are with the language of assault and descriptions of regions engaged in open combat with the explorer: "But could a shelter be found amid the wild battlements of the peak itself, which would enable one to attack the obelisk at day-dawn, the possibility of conquest … tempt[ed] a trial"; "We reached the first summit, and planted a flag upon it"; "the first huge missile appeared … I was directly in the line of fire, but, ducking behind the boulder, I let the projectile shoot over my head"; "he invited me to join him in an attack upon the untrodden peak"; "I resolved to make a last attack upon the unconquered hill"; "Mr Girdlestone and I, without any guide, made an attack upon the Aletschhorn".[67] Even the chapters detailing Tyndall's attempts to scale the Matterhorn are entitled 'The Matterhorn – [First/Second/Third] Assault'. These expressions not only play into the hands of critics like Ruskin (and later Turner) but also seem to

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[64] Bruce Hevly, 'The Heroic Science of Glacier Motion', *Osiris*, 2. 11 (1996), 66-86 (p. 67).
[65] Anon., 'Professor Tyndall Among the Alps (Book Review), *The Spectator*, 44 (1871), 922-23 (p. 923).
[66] Tyndall, *Hours*, p. 104.
[67] Ibid., p. 142; 198; 165; 189; 304.

undermine my earlier claim that matter forces Tyndall to think. Rather, they appear to imply that Tyndall sees the mountains as regions to be conquered and playgrounds in which to test his own strength.

On the surface then, adventurous exploration and the effort required to attain a state of verticality embodies a double function. It stands as a metaphor for the all-encompassing progress of materialism while furnishing the heroic explorer with added experiential clout. Bruce Hevly has demonstrated that other famous nineteenth-century mountaineers such as Leslie Stephen believed that direct interaction with nature, and the muscular exertion undertaken on the part of the climber, constituted an authoritative claim to empirical knowledge. Following Stephen's rhetoric, Alpinist scientists like Tyndall could thus speak of having undergone "a rigorous experience on behalf of science".[68] The more life-threatening or daring the experience and the greater levels of verticality attained, the more the theory in question could itself be grounded upon solid scientific principles. Tyndall's Alpine reports play with these tropes, his athletic strength and aptitude for climbing supposedly bringing him greater scientific knowledge too. Like the muscular Christianity of Charles Kingsley, the Alpinists saw sport and fitness as activities central to the promotion of physical, intellectual, moral and manly health.

Moreover, in predicating his metaphors on the vertical axis, Tyndall taps into pre-existing cognitive prejudices prioritising the value of height and extremes of difference. Consequently, the power and energies of Tyndall's own body and the virtuous qualities of disciplined exercise are inextricably woven into the textual fabric of his mountaineering journals. "The present volume," Tyndall writes in the preface to *Hours of Exercise*, "is for the most part a record of bodily action, written ... to preserve to myself the memory of strong and joyous hours".[69] Yet while these self-aggrandising and combative overtones provided Tyndall's critics with evidence of his vanity, there is

[68] Hevly, 'Heroic', p. 66.
[69] Tyndall, *Hours*, p. v.

also another interpretation in which confrontation with nature works to complicate the world/man divide.

The first of these is a form of *duality*. In both his bodily response to the world and its poetic expression on the page, Tyndall enters into a form of transcendental communion, far removed from deterministic, mechanical analysis. He and his surroundings are united in an aesthetic and spiritual bond, underscored by subjective experience, intuition and creativity. But whereas romanticism saw these qualities as antithetical to science, under Tyndallic duality, they constitute a key element of scientific inquiry. Their underlying logic is thus conjunction, pairing, and the addition of two parts to make a single whole. The second is a form of *duelity*, a radical ethics of (dis)embodied thought and action predicated on the abstraction of phenomenological experience. This aspect of Tyndall's materialism prises open the epistemological gap separating subject and the world to peer into its vertiginous depths. To derive "physical theories which lie beyond experience" Tyndall claims in the Address, demands "a process of abstraction from experience".[70] Like duality, this duelistic response constitutes a similar development of romantic principles but takes, as its predicate, the recognition of nature's awesome and awful powers. Rather than joining in harmonious communion with nature, it allows extreme forces to bend, twist and remould the body in order to produce a far-from-equilibrium experiential and physiological response.[71] While *duality* is a harmonious epistemological state of oneness, *duelity* is a fundamentally violent process: it involves ripping things apart and smashing them back together to make something new. In other words it is a willingly entered into combative process between the human body and nonhuman world. It is in this double bind of the dualistic and duelistic transformation of the sublime, in the oscillation between extremes of contemplation and action, spiritual reverence and the potential for

[70] Tyndall, *Address*, p. 52.
[71] As described in this thesis' Introduction, such bodily changes involve more intense processes of differentiation, having to pass through extreme critical thresholds to reach a temporary state of bodily non-equilibrium, i.e., outside of the ordinary, 'resting' state of the body that is its default mode.

existential terror, that poetic intuition and embodied knowledge play as important a role in Tyndall's materialistic science as analysis, logic and reason.

1.3 Poetic duality

The Alpine landscape was an environment in which Tyndall could recharge his store of energy away from the stressful commotion of London and push his physical and mental muscles to their utmost potential. From his days as a schoolboy in County Carlow, Tyndall's life was characterised by a dynamic interdependence of discipline and exertion that existed in a duality of extremes. Paul Sawyer recalls how Tyndall's almost excessive physical exuberance meant that he could often be found at the break of dawn "with a coffee bean in his mouth" doing schoolwork—only to arrive home late simply because he loved to fight with other children.[72] Tyndall's passion for confrontation and hard work extended into his adult life, culminating in the furious academic skirmishes he conducted with the Victorian intelligentsia. These battles were rarely undertaken solely "for the sake of his own reputation" but rather in a principled defence of intellectual territory that he believed his opponents had "no right to hold."[73] Ruth Barton claims that Tyndall did not have his friend Huxley's talent for irony and evasion and "believed that honesty required utter straightforwardness."[74] Tyndall was arguably more rhetorically sly and skilful than she, and others, recognise. Indeed, as will be suggested later, his use of certain terms such as 'force', 'vis viva' and 'elasticity' belies an awareness of their political, social and cultural, as well as scientific implications. Nevertheless, it is undeniable that confrontation for Tyndall was regarded as a moral compunction: a duty he was obliged to undertake, but one which nevertheless sapped

[72] Sawyer, 'Ruskin and Tyndall', p. 225.
[73] Arthur S. Eve and C. H Creasey, *The Life and Work of John Tyndall* (London: Macmillan, 1945), p. 282. ; John Tyndall, '"Materialism" and its Opponents.' *The Fortnightly Review*, 18, (1875), 579-99 (p. 579).
[74] Barton, 'Tyndall, Pantheist', p. 115.

his strength. As Tyndall reminded Carlyle in a letter written from Tennyson's house, "I have had to fight my battles ... I was landed here ... a weary man."[75]

Almost invariably then, Tyndall's reputation suffered sustained blows and along with these attacks, the dissipation of his personal energy. He would often arrive in the Alps suffering from exhaustion, headaches and insomnia after courting what he somewhat naively regarded as "unexpected amount[s] of criticism."[76] Indeed, the amended preface to the Belfast Address published by Longmans & Co. "was written under some disadvantages" in the Alps less than a month following the meeting.[77] However, it was often under such circumstances—"numberless strictures and accusations, some of them exceeding fierce"—that Tyndall's capacity for action thrived.[78] He used controversy and ire to fuel his strenuous exertion. Such was his disposition that the more physically demanding the activity, the more "good health set steadily in" and remembrance of the "symptoms" which drove him to the Alps subsided: "Each day's subsequent exercise made both brain and muscles firmer."[79]

It is not surprising, therefore, that Tyndall often foregrounded his own athleticism, given that renewed bouts of vigour signalled the sublimation "of doubt and discomfort, of gloom and ennui."[80] Indeed, the "love of being alone" nourished Tyndall's emotional intellect and sustained his almost childlike awe for the physical world.[81] Of course, Tyndall's enthusiasm for the natural world rendered him the butt of satirical characterisations. James Paradis, for example, describes how *Punch* writers "flatly lampooned" the physicist, dwelling on his "intense earnestness, which sought continually to coin deeply mystical significance out of thin air."[82] But considered

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[75] Tyndall, letter to Thomas Carlyle, 14th April 1878. *Correspondences of John Tyndall, Vol 1. 197. JT/1/TYP/1.*
[76] Tyndall, *Address*, p. v.
[77] Ibid.
[78] Ibid.
[79] Tyndall, *Hours*, p. 16.
[80] Tyndall, 'Scientific Use', p. 4.
[81] Tyndall, *Hours*, p. 180.
[82] James Paradis, 'Satire and Science in Victorian Culture' in *Victorian Science in Context*, ed. Bernard Lightman, (Chicago and London: University of Chicago Press, 1997), pp. 143–78 (p. 15).

alongside Ruskin's scathing attacks, such satirical characterisations expose a curious contradiction. On the one hand, Tyndall was cast as a dishonest, overly dogmatic narcissist determined to obviate the need for an affective account of nature by popularising a spiritless materialism. On the other, a sub-Wordsworthian fantasist whose naive idealism and efforts to connect the realms of poetry and science undermined the idiosyncrasies of both categories and rendered his meaning obscure: "No one could divine with certainty the exact position which the Professor takes up," claimed *The Observer* following the Belfast meeting.[83] Some of these inconsistencies along with the combative nature of Tyndall's language can be explained as a documentation of a character prone to emotional and energetic extremes, and partly as an effort to popularise uncertain scientific claims. But they profess to a more radical development of intensive materialism in which Tyndall attempts to imbricate his own body within the energy of the Alps and subsequently transfer it into language.

"Matter," he writes in the paper 'On Molecular Influences' (1853), "may be regarded as a kind of organ through which force addresses our senses; if the organ be changed, it is reasonable to infer that the utterance will be correspondingly modified".[84] In metaphorical terms, Tyndall's own material body acts as the organ through which the forces of external matter affect and modify sense and thought— vibrating in or out of tune with his surroundings. Thus, for every assertion of masculine energy in Tyndall's texts, there exists a passionate, almost metaphysical appreciation of the material world; for every dynamic noun and verb, an evaluative adjective and invocation of matter's complexity. His language is predicated both upon direct experience of material phenomena and, paradoxically, the idea that these phenomena also extend *beyond* experience. Thus, we find a duality in Tyndall's work defined by convergences between reason and imagination, spirit and matter, poetry and science, man and world. We have already seen in Tyndall's conquest of the Monte Rosa that he

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[83] 'Editorial Article–No Title', *The Observer (1791–1900)*, (1874), p. 4.
[84] Tyndall, 'On Molecular Influences. Part 1. Transmission of Heat through Organic Structures,' *Philosophical Transactions of the Royal Society of London*, 143 (1853), 217-31 (p. 217).

refuses to succumb to the temptation of reverence, focusing instead on his own power. Similarly, the final moments of his ascent of the Weisshorn are rendered in the semantics of doggedness, perseverance and struggle. These passages seem to support the notion that Nature, though not in itself passive, nonetheless yields to the active physical and intellectual strength of Tyndall the scientist climber. Yet these moments need to be read contextually. In fact, Tyndall populates his account of the Weisshorn ascent with detailed descriptions of rocks, ice, snow, streams and light and succumbs to the "glorious" and "noble" grandeur before him, which fluctuates and shifts in constantly evolving dynamism.[85] Such expressions are common in Tyndall and often appear not in opposition to, but in conjunction with metaphors of progress, depictions of strength and invocations of the sublime.

Indeed, 'power' for Tyndall is a complex concept. It is matter's immanent and autonomous morphogenetic capability to create mountains, trees, animals, and their properties, function and behavioural characteristics. But it also represents potential—the multiplicity of connections that can be made between things to produce or negate new possibilities for action, emotion, evolution, bodily interaction, and so forth: the potential for empowerment or disempowerment. Power, in the words of Gilles Deleuze and Felix Guattari, represents "a capacity to affect or be affected".[86] Tyndall's sublime encounters realise exactly this. Both he and the material world have the potential to affect and be affected. Tyndall finds a power in his muscular prowess, his ability to climb regions untouched by any other human, and in the language used to describe these adventures. But these moments—moments that are undeniably gendered as masculine and rendered in combative language—are also *combined* with and *complicated* by passages describing Tyndall being affected by sublime power. "When the work is clearly within your power" to traverse rocks and ice, "it is an entirely new experience to be alone amid those sublime scenes", writes Tyndall recalling his 1861

[85] Tyndall, *Glaciers*, p. 152-53.
[86] Gilles Deleuze and Felix Guattari, *A Thousand Plateaus*, trans. Brian Massumi (London: Continuum, 2004), p. xviii.

ascent of the Matterhorn.[87] Similarly, having utilised his own muscular powers to reach the summit of the Jungfrau, Tyndall remarks: “I had scarcely ever seen the Alps to greater advantage. Hardly ever was their majesty more fully revealed or more overpowering,” adding, “half the interest of such scenes is psychological; the soul takes the tint of surrounding nature, and in its turn becomes majestic.”[88] And similarly, standing on the peak of the Weisshorn, Tyndall declares “I had never before witnessed a scene which affected me like this one”.[89] He continues: “I opened my note-book to make a few observations, but soon relinquished the attempt. There was something incongruous, if not profane, in allowing the scientific faculty to interfere where silent worship seemed the ‘reasonable service.’”[90]

Tyndall’s poetic encounters with the sublime power of nature constitute not so much a delineation between science and near quasi-spirituality, as a divestiture and transfer of agency. In these moments, “the scientific investigator” is unable to quantify “a power which gives fullness and tone to his existence, but which he can neither analyse nor comprehend.”[91] Quantitative analysis of “the actual … the world that is” gives way to imaginative susceptibility of “the possible … a world which might be”.[92] These expressions of sublime awe affirm what Tyndall describes in the Address as those “elements of scientific enquiry [that] fall in with the discipline of the poet”.[93] Following Shelley, Tyndall’s dualism departs from the devotional sublime of Coleridge by conceiving the scientific and poetic as parts of the same truth. Likewise, Tyndall claims in the Address that Goethe “possessed extraordinary powers” in his “sharpness of observation … detection of analogies … [and] in the classification and organization of facts according to the analogies discerned”—even if, Tyndall adds, he could not always

[87] Tyndall, *Hours*, pp. 116-17.
[88] Ibid., p. 190.
[89] Ibid., p. 106.
[90] Ibid.
[91] Tyndall, ‘Scientific Use’, p. 38.
[92] Ibid.
[93] Tyndall, *Address*, p. 14

combine discrete information into "distinct mechanical conceptions".[94] For metaphysical insight and emotive expression, Tyndall also relies upon the poetry of Tennyson, Emerson and Wordsworth. In the spoken Address, Tyndall closes with his own poetic sentiment. Materialism, he says, is a noble field, and one "which will be handled by the loftiest minds ages after you and I, like streaks of morning cloud, shall have melted into the infinite azure of the past."[95] But while time is again the focus of the conclusion printed in the revised Longmans edition, Tyndall alters his closing remarks. Looking to the future, he sketches a "forecast … of the latest and deepest scientific truth" revealed by materialist inquiry. In place of his "infinite azure," however, he quotes lines 88-102 of 'Tintern Abbey', italicised from line 93 onwards: "And I have felt / A presence that disturbs me with the joy / Of elevated thoughts … And rolls through all things."[96] Both versions implicitly draw upon Tyndall's vertical experiences in the Alps: the image of clouds changing and melting in the sky and the "elevated thoughts" characteristic of Tyndall's 'services' with nature and imaginative science. Yet the revised ending also continues where the original left off in its poetic description of a power that, in Wordsworth's words, is "deeply interfused" in matter and "impels … all things".

One wonders whether Tyndall missed an opportunity to close his speech with an even more resonant poetic invocation. Indeed, Shelley's 'Mont Blanc' is similarly concerned with an immanent power that impels, affects and interfuses nature and consciousness. But Shelley goes further than Wordsworth in ascribing to the material universe ontological priority, with the mountain itself holding the "secret Strength of things / Which governs thought".[97] Indeed "The everlasting universe of things / Flows through the mind" and produces the "The source of human thought".[98] Shelley's inversion of Cartesian verticality is an impulse Tyndall is also keen to impress upon his

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94 Ibid., p. 14.
95 Tyndall, 'Belfast' original, p. 189.
96 Tyndall, *Address*, p. 65.
97 Percy Bysshe Shelley, 'Mont Blanc' in *The Selected Poetry and Prose of Shelley*, ed. Bruce Woodcock (Ware: Wordsworth Editions, 1994), 125-31 (p. 129).
98 Ibid., p. 125.

audience at Belfast: "Divorced from matter where is life to be found? … Every meal we eat, and every cup we drink, illustrates the mysterious control of mind by matter."[99] If this statement and the conclusion to the revised address could have been embellished by employing a quotation from 'Mont Blanc' instead of 'Tintern Abbey', it nonetheless demonstrates how for Tyndall, the poetic faculty constitutes a form of scientific discovery—a "creative power in which reason and imagination are united".[100] The material world being uncovered and brought into existence by the Victorians dealt with phenomena like orogeny that were not directly observable. In forming scientific conceptions of these insensible processes, "[i]magination becomes the mightiest instrument of the physical discoverer."[101] It charts new territories both in its individual expansion and openness to the sublime. Had we "been impregnated with the notion of the poet Goethe," Tyndall told the BAAS in 1870, we would see "matter, not as brute matter, but [channelling Carlyle] as the living garment of God". Our "repugnance to the idea of primeval union between spirit and matter might be considerably abated", replaced instead by a poetic and scientific appreciation of their "mysterious duality".[102]

For Tyndall, the ontological duality of spirit and matter demands an epistemological duality of poetry and science. These dualistic conceptions confounded or infuriated the physicist's critics—especially Ruskin. In fact, both Ruskin and Tyndall shared a common rejection of matter as brute. Poetry is not a fanciful adornment but a mode of thought that produces real understanding of the material and 'spiritual' world. Such is the accord between aspects of the men's thought that Ruskin's words describing his visionary aesthetics can also be used to define Tyndall's. Both philosophies are predicated on the interweaving of "artistic sensibility with scientific faculty".[103] Given this overlap, it seems odd that Ruskin and Tyndall disagreed with one another as vehemently as they did. On this point, Paul Sawyer notes that the men's relationship

[99] Tyndall, *Address*, p. 54.
[100] Tyndall, 'Scientific Use', p. 10.
[101] Ibid., p. 6.
[102] Ibid., p. 36.
[103] Ruskin, *Fors Clavigera*, XXVIII: as quoted in Edward Alexander, 'Ruskin and Science', *The Modern Language Review*, 64 (1969), 508–21 (p. 509).

constituted “an antagonism of resemblances”—that their similarities made each even more fiercely competitive.[104] The Forbes affair had descended to such bitter hostilities that reconciliation was almost impossible.

Nonetheless, these caveats ignore an important detail. Tyndall’s thought did not simply, as Sawyer claims, represent “the intersection of Romantic tradition with the triumph of scientific naturalism”.[105] Instead, it created something new. Whereas Ruskin sought “to re-sacralise the world, to recover the idea of the universe as ‘a single, symbolic whole,’”[106] Tyndall’s materialist ontology was predicated on the belief that matter is imbued with heterogeneous power. In the imaginative interweaving of reason and poetic intuition, he was able to connect more completely with this material immanence. But Tyndall’s materialistic dualism is defined by more than a reformulation of romantic poetic sensibilities found in moments of contemplative reflection, immersion in majestic Alpine scenes, imaginative exploration, and their expression in language. His communion with nature is also realised in the experience of climbing itself, in embodied encounters conjoining muscles, nerves and skin with the rocks, crevices and ice of mountains. But this form of corporeal experimentation went beyond the dualistic unity and insight of the poetic sublime. In the act of extreme climbing, Tyndall engaged in a form of embodied materialism that pushed his mind and body beyond the bounds of stable parameters.

1.4 Embodied duality / embodied duelity

In *Architectures of Time* (2002), an examination of the interplay between the physical sciences and the arts, Sanford Kwinter writes about the complex interaction between human and nonhuman ‘flows’ produced during extreme sports. Activities like climbing

[104] Sawyer, ‘Ruskin and Tyndall’, p. 217.
[105] Ibid.
[106] David Carroll, ‘Pollution, defilement and the art of decomposition,’ *Ruskin and Environment: The Storm-Cloud of the Nineteenth Century*, ed. Michael Wheeler, (Manchester: Manchester University Press, 1995), p. 61.

force upon the subject an embodied awareness of their specific, context-dependent orientation in space and time. Traversing a rock face, the climber's muscular movements, perception, balance, sensations of pain and fatigue and judgement, all have to be carefully calibrated in relation to the variables of the environment: crevices, overhangs, loose stones, wind, rain. For Kwinter, scaling vertiginous slopes of rock and ice, where the climber uses her/his hands and feet instead of ice axes, represents one of the most extreme forms of embodied encounter (Tyndall was himself a pioneer of this form of climbing, often preferring to climb on vertical slopes with his bare hands). It exposes the climber to non-habitual experiences, forcing them to think outside of phenomenological confines to participate in assemblages of becoming:

> the climber's task is less to 'master' in the macho, form-imposing sense than to forge a morphogenetic figure *in time*, to insert himself into a seamless, streaming space and to subsist in it by tapping or tracking the flows – indeed to stream and to become soft and fluid himself...[107]

Following the work of Deleuze, specifically in the conceptual vocabulary of flows, morphogenesis and fluidity, Kwinter's statement requires further elucidation. For Deleuze, 'flows' have a wide and complex place in his ontology. They constitute the forces of matter, energy, desire and experience before they are differentiated, separated, and classified. Flows are the differential elements (given direction by intensive attractors) that give rise to actual phenomena: the orogenic processes, for example, that create mountains. According to Deleuze, however, to make sense of the world we code these flows as static coordinates. To use Tyndall's own metaphor, we tend to imagine colours not as a contiguous spectrum but as individual qualities such as red, orange and blue, each with their own identity and defining properties.[108] Flows are thus envisaged as having a distinct consistency, continuity and order—they are territorialised. But territorialisation is more than the projection of human

[107] Kwinter, *Architectures*, p. 31.
[108] Tyndall, 'Scientific Use', p. 13.

intentionality onto matter. Life also territorialises itself, in the formation of unified wholes and machines—from the growth of a plant to the development of animal packs and tribes. Yet territorialisation is not unidirectional; the ordering of flows can be undone and repurposed, an operation Deleuze terms deterritorialisation. Again, this is something performed autonomously by matter as well as being an intentional action enacted by consciousness. In both cases, it is a form of decoding. Deleuze does not see either territorialisation or deterritorialisation as inherently good or bad. They are processes that on the whole remain ambivalent, having both productive and subtractive value. Thus, while deterritorialisation is to an extent a form of existential and epistemological escape which can be initiated by pushing thought in new, tangential directions, it also represents the ontological liberation of flows from their original function and can lead to destruction.

Deleuze and Guattari concretise these incredibly abstract ideas with the following example. "[T]he club", they write, "is a deterritorialized branch."[109] Used as a weapon, the branch is removed from its natural environment of the tree and ceases to perform its original operation: spreading leaves to absorb sunlight. The material flows that, until its separation, had made the branch a branch, are liberated. However, in the branch's new assemblage with the arm as a weapon, these flows are reterritorialised within a new context. When Kwinter writes that the climber's task is to 'tap and track mountainous flows', he is thus describing a particular kind of experiential de- and re-territorialisation (although, as we will later see, only a partial kind). Climbing is a form of negotiation; it requires awareness of both the body and the environment in space and time. Situated on the face of a rock, the climber's 'ordinary' bodily activities, sitting, eating, standing, relaxing, actions that slip through time unnoticed, are replaced by an intense muscular, sensory and perceptual awareness. The body is deterritorialised and reappropriated in assemblages with the natural environment: it functions not within its original bounds but becomes climber. In becoming "soft and fluid" by entering into a

[109] Deleuze and Guattari, *Thousand Plateaus,* p. 191.

dualistic encounter with the mountainside, the climber is thus able “momentarily to recover real time”—“to engage the universe’s wild and free unfolding”.[110]

Tyndall’s embodied encounters in the Alps did exactly this. Though he did not have the conceptual vocabulary of Deleuze, his Alpine journals continually recount processes of experiential deterritorialisation. This was fundamental to Tyndall’s science. In his 1870 BAAS lecture on the scientific use of the imagination he asks how the ontological flows of matter—“those hidden things ... like that of life itself” which lie beyond “the domain of the senses”—come “to be revealed”.[111] To liberate physical intensities, the scientist has to destabilise the mind itself. Hence, while “philosophers may be right in affirming that we cannot transcend experience,” says Tyndall, “we can, at all events, carry it a long way from its origin. We can also magnify, diminish, qualify, and combine experiences, so as to render them fit for purposes entirely new.”[112] Writing a century before Deleuze, this is an extraordinary description of phenomenological deterritorialisation, particularly in its focus on carrying experience a “long way from its origin [or territory]” and combining it in new assemblages to make it function in “entirely new” ways. Thus, the question for Tyndall, later put by Deleuze as follows, is: “how can we unhook ourselves from the points of subjectification that secure us, nail us down to a dominant reality?”[113] How do we subtract the branch from the tree to create the club? In pursuit of the answer to this problem, *elasticity*, both in its scientific territory and reappropriation as bodily performativity, will become key to Tyndall’s own form of de/reterritorialisation. Indeed, it is in elasticity—of form, function, purpose and action—that corporeal consciousness is able to think and act outside the normal bounds of experience and forge smooth spaces of intensive time on the mountainside.

During a particularly arduous climb of the Weisshorn with Bennen in 1861, Tyndall finds that he has to, in Kwinter’s words, “become soft and fluid” in order to

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[110] Kwinter, *Architectures*, p. 31.
[111] Tyndall, ‘Scientific Use’, p. 6
[112] Ibid.
[113] Deleuze and Guattari, *Thousand Plateaus*, p. 177.

avoid dislodging loose rocks, cramping, or falling. A metaphorical way of saying he was 'in tune with his surroundings', perhaps, but it goes beyond this too. Tyndall's body has to respond to the locality of a given ledge or slope, to the constantly evolving conditions of the environment. He cannot, as Kwinter puts it, rely on a "command *center* that [has] programmed the body to behave globally in response to fixed or … *average* conditions [emphasis original]."[114] Tyndall's movements through time and space thus become slow and deliberate and punctuated by periods of rest as his body begins to 'stream' within the spatiotemporal flows of the mountain. It ceases temporarily to be a collection of limbs and organs but a "little machine … plugged into other collective machines" through which flows a "conjunction of flows, [a] continuum of intensities."[115] Nevertheless, this change is not permanent and requires continual adjustment to maintain. For Tyndall, the force of the experience becomes instructive. "[A]t every pause the muscles became set, and some minutes were necessary to render them again *elastic*. But for both mind and body the discipline was grand [emphasis mine]."[116] Crucially, this is not a process of mirroring, or appropriation. If this were the case, Tyndall's "set" muscles would only analogically *resemble* the hardened rock. Rather, mountainous solidity and stasis are recognised as concepts entirely dependent on a particular temporal framework. As soon as time is considered as intensive and heterogeneous, flow and 'elasticity' become accurate depictions of the mountains, with their recumbent folds and continually shifting matter. When Tyndall's muscles become set, he is unable to continue climbing. The assemblage between body and mountain, forging a particular becoming through time, is momentarily suspended, but nonetheless poised to resume its unfolding.

Tyndall continues:

[114] Kwinter, *Architectures*, p. 30.
[115] Deleuze and Guattari, *Thousand Plateaus*, p. 179.
[116] Tyndall, *Hours*, p. 101.

There is scarcely a position possible to a human being which, at one time or another during the day, I was not forced to assume. The fingers, wrist, and forearm were my main reliance, and as a mechanical instrument the human hand appeared to me this day to be a miracle of constructive art.[117]

Note here the transference of affective agency between mountain and human. Tyndall is "forced to assume" a huge variety of positions, his body not simply subsisting in time and space but pushed to its limits, responding to the uniquely specific durations and spaces of the rock face. Moreover, Tyndall's hand, fingers, wrist and arm become his "main reliance". They are what keep him connected to the rocks, preventing him from falling. In this encounter, they have a specific, localised function, working together as a "mechanical instrument" of climbing: a function they would not ordinarily have outside of this entangled bodily space. These bodily components cease to be defined by what they *are*, but what they can *do*. In climbing, Tyndall thus enacts Deleuze and Guattari's experimental manifesto for the realisation of phenomenological abstraction and the deterritorialisation of flows of material power:

Lodge yourself on a stratum, experiment with the opportunities it offers, find an advantageous place on it, find potential movements of deterritorialisation, possible lines of flight, experience them … It is through a meticulous relation with the strata that one succeeds in freeing lines of flight, causing conjugated flows to pass and escape and bringing forth continuous intensities.[118]

The "meticulous relation" Tyndall's body maintains with the mountainous surroundings is in constant flux; he cannot rely on a pre-programmed course of muscular action. "[F]linging myself suddenly from rock to rock," he writes, "I proved my condition by experiment instead of relying on surmise."[119] When fatigue does set in, the delicate assemblage between Tyndall and the mountain becomes unbalanced, forcing him to recalibrate his muscles: "We were roused from our stupefaction at times by the roar of the stones which we loosed from the ridge and sent leaping down the

117 Ibid., p. 102.
118 Deleuze and Guattari, *Thousand Plateaus*, p. 178.
119 Tyndall, *Hours*, p. 103.

mountain."[120] Thus although Tyndall proves that his body is capable of performing a near infinite combination of positional movements, its possibilities are only realised by, in his words, rendering it "again *elastic*". More than simply a relaxation of the muscles before their next contraction, elasticity constitutes at this moment a bodily epistemology. A stratified or statistical response to *likely* conditions would result in ultimate deterritorialisation—death. He treats the mountain therefore not as a homogenous type, but as a shifting, heterogeneous system. As Kwinter writes, every "square centimeter represents its own interdependent dynamical system", demanding, in turn, elastic transformations of the climber's body.[121]

"Elastic" is the key word in this passage, not simply because it chimes with Kwinter's, and by extension Deleuze's terminology. It also shows how Tyndall forged conceptual connections between ideas by importing scientific terms and their inherited technical meanings into new contexts. Indeed, Tyndall's bodily elasticity borrows some of the 'coded flows' from the mechanical notion of elasticity. Understanding what elasticity means in a scientific context thus allows for a more nuanced appreciation of how it is reappropriated as an embodied mode of thought. Elastic materials are malleable. When external forces are applied to them they undergo deformation, tending toward a specific state, such as flowing or being squeezed or stretched. When these forces are removed, elastic objects are able to return to their approximate original form. Deformation is only temporary. Most materials have an 'elastic limit': a stress threshold that, if exceeded, causes breakage, structural failure or permanent deformation. Even so, below this limit, elastic materials can be modified, shaped and distorted in numerous ways while retaining the capacity to return to roughly their latent state of equilibrium.

Because of these properties, elasticity became a useful demonstrative concept in Tyndall's science. When searching for an experiment that would help the public to visualise musical vibrations, he found that hitting an iron poker with a hammer would

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[120] Ibid., p. 107.
[121] Kwinter, *Architectures*, p. 31.

produce “transverse standing waves” through a piece of elastic material tied at one end to the poker and at the other to the ceiling.[122] Experimenting with elastic cords of differing lengths, thickness, density and resistance, Tyndall found he could visually represent various harmonic frequencies. Beyond these demonstrations, elasticity also featured prominently in Tyndall’s broader scientific work on sound. When investigating the propagation of sound waves, Tyndall discovered a proportional relationship between their velocity and the density and elasticity of air. This theory of atmospheric elasticity was further developed when oriented in a vertical context. For Tyndall, elasticity was a measure of a gas’s pressure, and its resultant compressive and expansive properties. He realised that this measure of ‘springiness’ was not consistent, but instead dependent on numerous variables—particularly height. Thus, the “elasticity of the air upon the summit of the mountain” Tyndall showed, “is not much more than half what it is at the sea-level.”[123]

In the Alps, Tyndall also pondered how even the most hardened of inorganic matter had, when considered over immense periods of time, malleable qualities. During his 1856 Alpine tour with Huxley, the contortions, folds and compressions of geological strata astonished Tyndall. It prompted him to think back in time and wonder about the “physical condition of the rock when it was … bent and folded like a pliant mass.”[124] Such a gargantuan amount of energy, which would cause fracture if communicated to the rock at once, is “harmless when distributed over” a greater period of time. A “solid rock” might therefore, “by ages of pressure be folded”.[125] Tyndall recognised that not even mountains were static. No body, organic or inorganic “is perfectly hard, none perfectly soft, none perfectly elastic. The hardest body subjected to

[122] Charles Taylor, *The Art and Science of Lecture Demonstration* (New York: Taylor and Francis, 1988), p. 105.
[123] John Tyndall, *Sound. A Course of Eight Lectures Delivered at The Royal Institution of Great Britain* (London: Longmans, Green, and Co., 1867), p. 24.
[124] Tyndall, *Glaciers*, p. 9
[125] Ibid.

pressure yields".[126] Objects that appear solid and continuous to the senses are considered in terms of their durational intensities. But so too are the very properties of hardness, softness and elasticity. Moving through time and being subjected to forces always changes matter, the body and the mind. The affective forces Tyndall encounters in moments of sublime revelation and climbing, for example, would not be possible without the primordial forces of matter changing the geological strata on which he is lodged.

Tyndall's 'elastic' experiments thus showed him that substances were capable of assuming a wide variety of malleable states, behaved in different ways depending not simply on particular manifestations of force but also environmental variables, and that elasticity implied returning to a resting state of equilibrium. Moreover, Tyndall realised that a certain degree of elasticity, both as a physical characteristic and a conceptual mind-set, could be realised in his own pliant body. But while the elastic body oscillates between states of deformation and return, it too has a physical threshold beyond which it is destroyed. The embodied mind however, can be pushed much farther, behaving not only elastically but also *plastically*—the capacity to be deterritorialised and moulded into something permanently new.

Elastic deformation is thus a crucial component of Tyndall's experiential ethics and embodied dualism. But it still does not address the combative side of Tyndall's character that so riles Ruskin: his 'macho, form-imposing' mastery, his apparent need to fight the mountains. Tyndall's encounters with Nature were not always characterised by these elastic process of deterritorialisation and reterritorialisation, where external force is contained within overall elasticity—the rock being slowly folded through time; the body being deformed through local encounters with the evolving landscape of the mountainside. Instead, this other element of the Tyndallic encounter is defined by

[126] Ibid. Consider also the similarity between Tyndall's language here and that in these words by Deleuze: "a body has a degree of hardness as well as a degree of fluidity … it is essentially elastic, the elastic force of bodies being the expression of the active compressive force exerted on matter." Deleuze, *The Fold: Leibniz and the Baroque*, trans. T. Conley (London: Continuum, 2006), p. 6.

duelity, where directly oppositional forces clash with extreme energy and material powers flow not only 'with' but also 'across' the body. Nature, while being ordered, harmonious and elastic, is also disordered, fractured and full of tensile forces. Consequently, Tyndall was forced to respond with his own assertive force, to avoid permanent injury or death. In placing or finding himself in life-threatening environments Tyndall was pushed to the threshold of his 'elastic limit', and thus channelled Edmund Burke's assertion that "terror … either more openly or latently [is] the ruling principle of the sublime."[127]

Earlier in this chapter, Tyndall's reformulation of the romantic sublime was examined in relation to the "reasonable service[s]" and awe-filled encounters that often took place on Alpine peaks. On the summit of the Morteratsch, for example, (a few hours before the avalanche), Tyndall is overawed: "the succession of surprises experienced through their changes were such as rarely fall to the lot even of an experienced mountaineer."[128] "Clouds" he says, "differ wildly from each other in point of beauty, but I had hardly seen them more beautiful than they appeared today". A brief account of the men's climb down the mountain follows, culminating in Tyndall's thrilling description of the avalanche. A false step, a rush of snow, and in an instant, the men find themselves "riding downwards with uncontrollable speed on the back of an avalanche".[129] Dynamic nouns—"shock; speed; impetus; pressure; motion; collision; force; momentum"—replace the evaluative adjectives used to describe clouds, as Tyndall's words themselves tumble over one another, cascading like the mountainside.

And yet, this massive and unexpected shock to the body, "violently jerked" out of equilibrium, has a curious effect on Tyndall.[130] In contrast to the (expectedly) serene sensibility engendered by clouds, and even the dangerous, arduous, yet still disciplined mode of body-mind elasticity entered into when scaling the Weisshorn, Tyndall's

[127] Edmund Burke, *Into The Origin Of Our Ideas Of The Sublime and Beautiful* (New York: Harper & Brothers, 1856), p. 73.
[128] Tyndall, *Hours*, p 208.
[129] Ibid., p. 212.
[130] Ibid.

mental response to the avalanche (or at any rate, his recollection of it), is harder to categorise in terms of stable, singular states. For a moment, he experiences abject terror alongside the acceptance of his own death: "I thought of [Johann Joseph] Bennen on the Haut de Cry [Tyndall's guide and friend killed in an avalanche in 1864], and muttered, 'It is now my turn.'"[131] But Tyndall claims he was possessed not by "intolerable dread" but by a "kind of condensed memory, such as that described by people who have narrowly escaped drowning." An instinctual focus is forced upon him: "my power of reasoning remained intact".[132] This 'forced' mental state embodies a curiously paradoxical structure. On one hand, Tyndall is acutely bound up with the physical present, demonstrated through repetition of the adverb "immediately" and his admission that "the excitement of the rush [was] too great to permit the development of terror." Tyndall's terror is kept at bay by a huge surge of adrenaline and its inability to accumulate over time. It is as if he experiences a fleeting succession of individual moments divorced from contiguous, continuous duration. But this fusion of body and mind in the "moment" is also offset by an equally extreme separation between body and mind. Because, on the other hand, Tyndall's thoughts are flung away from his present circumstances, into the past—"I thought of Bennen…"—and the future—"Looking in advance…"; "Destiny had so related…".[133] These mental states can be considered not only in respect to their temporal qualities but also their spatial arrangement. Like a rubber ball, the mind is both capable of violent expansion and contraction, imaginative amplification or focussed compression.

Moreover, Tyndall finds he is able to plan responsive action in advance by bringing his knowledge of mechanical principles to bear on likely events. As such, the fall also becomes an object lesson in kinetic energy, a wild, impromptu experiment in which the men themselves become the primary variables. Tyndall describes how he and Jenni attempt to generate an "opposing force" to counteract their motion by planting

[131] Ibid., p. 214.
[132] Ibid.
[133] Tyndall often talked about the power of thought in these terms. See for example 'Scientific Use', pp. 7-12.

their ice picks in the ground; these are “rudely tossed” from their clutches.[134] This momentarily distracts him, but quickly Tyndall’s assessment of the situation reverts to the scientific: “I coolly scanned the men in front of me, and reflected that, if their *vis viva* was the only thing to be neutralised, Jenni and myself could stop them.”[135]

Vis viva is a curious term. Because in spite of the abundance of energetic words, rest, motion, pressure and so on, it moves the account away from a purely deterministic description of equal and opposite reactions. Long before the 1860s, the seventeenth-century concept was regarded as archaic and inaccurate, replaced with the more specific theories of ‘actual’ and ‘kinetic’ energy. It was also ‘foreign’, having been proposed by the German Gottfried Leibniz. The theory seemed to contradict the conservation of momentum by conceiving instead of an active power immanent to matter. But this was more than a scientific difference. It was, as John Henry notes, “a fundamental clash of worldviews”—religious, metaphysical, spatial, scientific and temporal.[136] Ultimately, the *vis viva* theory was shown to be inaccurate. But it is hard to believe Tyndall would casually use a term so laden with “figurative baggage”.[137] The term moves the energetic focus of the account away from strictly mechanical, causal operations to imply instead that agency is an integral property of matter. Although on first glance, *vis viva* is given to the falling men through the possessive pronoun ‘their’, the origin of this immanent force is generated by a coming together of the men *and* mountain. In this experience, so rare and distinct from ‘average’ encounters with reality, Tyndall is humbled by the awesome power of Nature. Thus, in a split second, the harmonic balance between human and nonhuman is burst apart, momentarily revealing a glimpse of matter’s incomparable magnitude.

This extreme encounter was not invited or expected but nonetheless oriented at the extreme end of Tyndall’s encounters with Nature. Without his considerable

[134] Tyndall, *Hours*, p. 213.
[135] Ibid., p. 214.
[136] John Henry, ‘National Styles in Science: A Possible Factor in the Scientific Revolution’ in *Geography and Revolution*, eds. David N. Livingstone and Charles W. J. Withers (Chicago: University of Chicago Press, 2005), pp. 43-74 (p. 61).
[137] Gold, *ThermoPoetics*, p. 52.

experience and a huge amount of luck, the men would likely have all died in the fall. Although this process still relies on the incessant interaction between organism and environment, elastic deterritorialisations are replaced by shocking, extreme and oppositional deterritorialisations. While Tyndall's efforts to abstract experience from phenomenological grounds were predicated on encounters with both a poetic and embodied form of sublime duality, these interactions always had the potential to become life threatening and overwhelming. For the most part, the danger these encounters posed could be balanced alongside the adventurous deterritorialisation they offered. But for Tyndall, finding this optimal elastic middle ground is a complex and risky venture. Indeed, the productive value

> of 'the sublime' … depends very much, I think, on a certain balance between the forces of nature and man's ability to cope with them; if they are too weak, the scene fails to impress; if they are too strong for him, what was sublime becomes only terrible.[138]

This tension between too weak or too extreme sublime forces is a constant concern for Tyndall. When describing an assault by falling boulders, he admits: "I had never before witnessed an exhibition of force at all comparable to this, and its proximity rendered that fearful which at a little distance would have been sublime."[139] The threat of physical and mental annihilation is, however, an unavoidable part of extreme activities like climbing. As Deleuze later echoed when describing the dangers of experiential deterritorialisation: "you can botch it. Or it can be terrifying and lead to your death".[140] Yet the majority of the passages in which Tyndall describes *his* assaults on the mountains coincide with these times when nature threatens to overpower him. Indeed, his 'forceful' actions constitute in part a resistance to these external blows. Often, "standing on the summit of a peak of ice and looking at the pits and chasms beneath me," he writes, "I experienced an incipient flush of terror. But this was immediately

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[138] Tyndall, *Hours*, pp. 44-45.
[139] Ibid., p. 329.
[140] Deleuze and Guattari, *Thousand Plateaus*, p. 166.

drowned in action."[141] Reasserting his physical and mental powers in the face of abject terror was a way to avoid complete deterritorialisation. As Deleuze makes clear, "You have to keep enough of the organism for it to reform each dawn; … you have to keep small rations of subjectivity in sufficient quantity to enable you to respond to the dominant reality."[142]

In opening his mind and body to the awesome and awful forces of matter, Tyndall was very nearly killed. But in the aftermath of being exposed to nature's intensities, he was still able to transform these sensations, experiences and thoughts into new scientific perspectives. Most significantly, he indirectly glimpsed the morphogenetic material processes and deep time scales which produced geological wonders and living forms. Combined with scientific observation, Tyndall's elastic and extreme materialist mode of embodied exploration thus allowed him to develop a theory of time and matter understood in nonhuman terms. But Tyndall found that a purely scientific description of this ontological reality was impossible. To capture time's absurd logic, he had to find a way of writing it into existence by provoking in his readers a similar form of anti-subjectivist thought. How he tackled this problem, particularly in his use of mythological legend, is the subject of this chapter's final section.

1.5 From vertical to horizontal; from moments to the momentous

The earth's age was only estimated with real accuracy in the twentieth century. But the Victorians were among the first to consider the immense timescales and colossal lateral forces involved in building mountains. While the figures proposed by Victorian scientists seem almost naively low, thinking about geological processes taking place over hundreds of millions of years was still a great conceptual leap. Tyndall was by no means the first scientist to ponder these ideas: the doctor and naturalist James Hutton

[141] Tyndall, *Hours*, p. 335.
[142] Deleuze and Guattari, *Thousand Plateaus*, p. 178.

introduced the idea of 'deep time' in *Theory of the Earth* (1785). Yet Tyndall was still one of the first to think with seriousness about the implications of time outside of phenomenological bounds. Indeed, he was acutely aware of the disruptive implications, scientific, theological and emotive, posed by varying estimates as to the earth's age.

In 1862, William Thomson suggested that the earth must be between 20-400 million years old. Thomson quickly reduced the upper end of this figure by a factor of four, to 20-100 million years, with the lower end of the estimate gaining widespread acceptance. This was bad news for geologists and biologists. A planetary age of tens of millions of years was not nearly long enough to allow for evolution and discredited the steady-state theory of Lyell. Yet Thomson was (at first) convinced his calculations were correct and the uncompromising geologists had overlooked "the essential principles of thermo-dynamics".[143] Darwin was haunted by this analysis because he knew that it undermined his theory. Try as he might to ignore his presence, Thomson loomed over his work "like an odious spectre."[144] Tyndall's own estimates of the earth's age are far less specific than Thomson's, though it is clear that his years number into the hundreds of millions given the prominence evolutionary and geological theories have in his work. This does not mean he rejected, or even sought to lessen the impact of thermodynamic theory. Nonetheless, the temporal tension between the two theories remained; a problem as much scientific as it was religious and personal. Consequently, in spite of his view that thermodynamics represented a unified theory of force, when it came to the question of Darwinian or Thomsonian time, Tyndall seemed to align himself with the former.

In his retelling of the Morteratsch avalanche, Tyndall contemplated the time of 'split-seconds': of sudden movements taking place in the "twinkling of an eye". 'Alpine Sculpture', the chapter immediately following the account of the accident, moves in

[143] William Thomson, 'On the Secular Cooling of the Earth,' *Transactions of the Royal Society of Edinburgh*, 23 (1862), 157-69 (p. 157). Thomson's calculations conformed to the physics of the time, yet did not include then undiscovered concepts about radiation.
[144] Letter from Darwin to Alfred Wallace, 1871. As quoted in Loren Eiseley, *Darwin's Century*, (New York: Anchor, 1961), p. 235.

typical Tyndallic fashion to consider the opposite extreme: the deep time taken to forge mountains. Whether or not this structural decision is intentional, the chapters' placement initiates a shift from the territory of phenomenal human time to the territory of geological time. In his writing, Tyndall was fond of making rapid leaps across spatiotemporal scales, from the very large to the very small, and back again. This rhetorical strategy represents a linguistic approximation of his poetic and embodied encounters. Having conducted experimental work in the field, Tyndall subsequently attempts to render his findings in writing, so that his readers can glimpse the wild physical reality lurking beyond common sense. Modern critics, in particular Maria Yamalidou, have noted that this is most commonly expressed in Tyndall's fixation with the molecular. For her, Tyndall's presentation of an everyday process such as crystallisation from the perspective of individual particles is a deliberate rhetorical manoeuvre intended to provoke the imagination into crossing the boundary between the sensible and insensible.[145] The same is true in the arrangement of *Hours*' chapters which move rapidly from subjective time to orogenic time.

Tyndall's avalanche experience lasted a few minutes, a stretch of time inconsequential when compared with the eons of geological time. One way of conceiving this difference is by imagining the events on the Morteratsch as a single temporal molecule. Figured this way, the durational intensities Tyndall describes in the following chapter can be thought of as a whole ocean of these temporal molecules. It takes a few seconds for Tyndall to fall down the mountain; it takes millions upon billions of seconds for the mountains to form.[146] To help his readers conceive such immensity, Tyndall takes them on a journey of discovery by starting his chapter in the familiar realm of ordinary experience. "In the falling of a rock from a mountain-head," he writes, "in the shoot of an avalanche, in the plunge of a cataract, we often see more

[145] Maria Yamalidou, 'John Tyndall, The Rhetorician of Molecularity. Part One. Crossing the Boundary Towards the Invisible'; 'Part Two. Questions put to Nature', *Notes and Records of the Royal Society of London*, 53 (1999), 231-42; 319-31.
[146] (Roughly 2.05120000e15, which equals approximately 2 million x 1 billion).

impressive illustrations of the power of gravity than in the motion of the stars."[147] Tyndall's gerunds and verbs evoke the temporality of experiential speed and motion. But soon he plunges into the realm of deep time, imploring his readers to actively engage their imaginations:

> Think of the ages which must have been consumed in the execution of this colossal sculpture. The question may, of course, be pushed to further limits. Think of the ages which the molten earth required for its consolidation.[148]

Whereas Thomson believed the earth's transition from a molten to solid state could be measured in tens of millions of years, Tyndall casts doubt upon such specificity by refusing to give an exact figure. He also frames the issue in more philosophical terms. A vast conceptual chasm separates the ability to think of a rock falling from a mountain from the ability to think of that same rock's consolidation and erosion through the ages. It is a chasm that Tyndall implores his readers to leap across—"Think … Think"—yet one he knows into which they will fall. This is the point. In the account of the avalanche he presents a 'molecule' of time—a single, human oriented event. In the following chapter, however, he shifts to a multitude of temporal molecules forming a vast mass of time—from the moment to the *momentous*. Thus, in what constitutes a sly dig at Thomson's precise calculations and their prediction of an earth aged only in millions of years, Tyndall tells his readers that the "vaster epochs" of reality are defined "through our inability to grasp them. They bewilder us".[149]

To be clear: Tyndall does not refute Thomson outright; nor does he suggest that precision has no role in science. Rather, he addresses both scientific and affective concerns. Scientific, because, like Darwin's estimates concerning the denudation of the Weald, he believes that geological and evolutionary processes can only take place over

[147] Tyndall, *Hours*, p. 251.
[148] Ibid.
[149] Ibid.

hundreds of millions of years.[150] Either Thomson had miscalculated or some as yet unknown phenomenon had not yet been discovered (radioactive decay, discovered 1896). And affective, because Tyndall forces his readers to think about matter in non-phenomenological terms. This latter concern is consolidated with the chapter's focus on intensive lateral forces. Instead of merely describing the mountains around him, Tyndall gestures towards the story behind the formation of the vast alpine sculpture: a story with no single author, a sculpture with no external sculptor. Upon finding the upper slopes of a gorge covered with rounded stones, Tyndall writes that there "was no agency in place to roll these stones … but the river which now rushes some hundred feet below them."[151] In the previous chapter, a human cause (the slip of a foot) produces a nonhuman effect (the avalanche). But throughout this chapter, intentional agency is nowhere to be found. Indeed, below a junction of two streams close to the Bernina paths, a "river flows through a channel cut by itself".[152] Again, smooth, rolled stones are found at the riverbed, but these, along with the gorge cut through the mountains, are the result of what Tyndall terms "the abstract power of water".[153] With time, even the slowest trickle of water can carve deep gauges in rock. Thus, the *power* of power is in part a function of time.

'Power' is a crucial concept for Tyndall and is used again only a few pages later: "To make ice slide over itself requires great power."[154] But more than simply a manifestation of force, power is for Tyndall synonymous with the intensive conditions driving material processes. References to the latent 'power' of Nature permeate all of Tyndall's texts. In a passage in *Hours*, Tyndall describes how, by being immersed in the natural world,

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[150] Darwin gives an exact figure for this estimate, assuming a supposed denudation of one inch per century: "306,662,400 years; or say three hundred million years." Geologists and biologists were of the mind that if this many years were required to erode the Weald, many more were required to deposit the chalk in the first place. Darwin subsequently changed this assertion in later editions, after his methodology was brought into question. Charles Darwin, *On the Origin of Species*, (Oxford: Oxford University Press, 1996), p. 232.
[151] Tyndall, *Hours*, p. 220.
[152] Ibid., p. 226.
[153] Ibid.
[154] Ibid., p. 239.

one's thoughts involuntarily revert to the ancient days, and we restore in idea a state of things which had disappeared from the world before the development of man. Whence this wondrous power of reconstruction? Was it locked like latent heat in ancient inorganic nature, and developed as the ages rolled? Are other and grander powers still latent in nature, destined to blossom in another age? Let us question fearlessly, but, having done so, let us avow frankly that at bottom we know nothing; that we are imbedded in a mystery, towards the solution of which no whisper has been yet conceded to the listening intellect of man.[155]

This was written in 1861. Thirteen years later, at the Belfast meeting, Tyndall reiterates the same point. The conclusion of the Address is equally concerned with the "mysterious" operations of Nature and in particular, the phenomenological boundary one hits when attempting to explain the "mysterious power" of matter in deterministic terms.[156] Indeed, rather than illuminate these dark regions of knowledge, thirteen years working in the light of scientific enquiry plunges these concerns into even more shadow. As such, the only difference in Tyndall's thought between 1861 and 1874 is the *greater* emphasis he confers to both the word and notion of intensive 'power'. The more he discovers about the world, the more he realises it cannot be regulated by reason alone.

Perhaps most telling, however, are the revisions made to the Address that appear in the Longmans edition published later that year. Aside from a further eleven instances of 'power', the changes made to one particular sentence bear further scrutiny. The line concerns his claim that in tracing all forms of life back to the ultimate particles of matter, he is compelled, like Lucretius and Bruno, to view Nature as the "universal mother who brings forth all things" "spontaneously of herself without the meddling of

[155] Ibid., p. 68.
[156] Tyndall, Address, 46. Earlier in the Address, Tyndall stages a mock debate between Bishop Joseph Butler and a Lucretian disciple concerning the limits of deterministic materialism. Both figures act as a mouthpiece for Tyndall, allowing him to expose the problems encountered in attempting to account for "logical continuity between molecular processes and the phenomena of consciousness". As Tyndall elsewhere stated: "This is a rock on which materialism must inevitably split whenever it pretends to be a complete philosophy of life." The implications of this line, amounting to a total disavowal of 'base' materialism, seem to have been lost on many of Tyndall's audience (pp. 33-34).

the gods".[157] In the original speech, published a few days after the meeting in *The Times* and *Nature*, the line appears as follows:

Abandoning all disguise, the confession that I feel bound to make before you is that I prolong the vision backward across the boundary of experimental evidence, and discern in that matter, which we in our ignorance, and notwithstanding our professed reverence for its Creator, have hitherto covered with opprobrium, the promise and potency of every form and quality of life.[158]

Periodicals pounced on the sentence. *The Athenaeum* suggested that the "origination of life, a point lightly touched upon, if at all, by Mr. Darwin and Mr. Spencer, is freely handled by the speaker".[159] *The Spectator* followed suit: "Any cause for Matter is an inference, a guess, which no scientific man is warranted in making."[160] Many others, meanwhile, quoted the line in explicitly sarcastic parenthesis. Tyndall himself remarked in a subsequent essay later that year (facetiously titled 'Apology for the Belfast Address') that this single sentence from his lecture was the one "expression to which the most violent exception has been taken".[161]

In spite of this reaction, the textual revisions to the Longmans edition show Tyndall entrenching his position, and clarifying the somewhat awkward and prevaricatory language of the original sentence. As it appeared later that year:

By an intellectual necessity I cross the boundary of the experimental evidence, and discern in that Matter which we, in our ignorance of its latent powers, and notwithstanding our professed reverence for its Creator, have hitherto covered with opprobrium, the promise and potency of all terrestrial life.[162]

[157] Tyndall, *Address*, p. 55.
[158] Tyndall, '"The Belfast Address", *Nature*, 20 August, 1874' in *Science and Religion in the Nineteenth Century*, edited by Tess Cosslett, (Cambridge: Cambridge University Press, 1984), pp. 172-89 (p. 183).
[159] 'British Association for the Advancement of Science, Belfast Meeting, 1874. Address.' *The Athenaeum*, 2443 (Aug 1874), 231-33 (p. 233).
[160] 'Professor Tyndall's Address.' *The Spectator*, 47 (Aug 1874), 1057–58 (p. 1057).
[161] Tyndall, *Fragments of Science*, 2 vols (New York: D. Appleton and Company, 1892), II, p. 207.
[162] Tyndall, *Address*, p. 55.

What began in the first edition as a "confession" to the audience becomes now an "intellectual necessity": a mode far more characteristic of Tyndall's forceful sense of duty. "[W]hich we in our ignorance", a somewhat standalone clause in the original sentence, is now clarified in terms of matter's "latent powers", a remark that contrasts the notion of immanent internal organisation with the external determination of a "Creator". And, the promise and potency "of every form and quality of life" is shortened and given figurative grounding by its change to "terrestrial". It is clear that this version of the sentence is more typically Tyndallic, in terms of both its added rhetorical clarity and demarcation of "our ignorance" in the face of material complexity. Yet it is because of this that Tyndall can argue more convincingly for encouraging the scientific imagination's fertility. Indeed, the latent powers of matter—chemical, biological, geological and energetic—are measurable up to a certain limit. As Tyndall makes clear in an additional line inserted just before the sentence quoted above: "Believing as I do in the continuity of Nature, I cannot stop abruptly where our microscopes cease to be of use."[163] Once again, empirical constraints demand the expansion, not contraction, of the scientific imagination. In every observable field and at every observable scale of organic and inorganic matter, Tyndall finds complexity and self-organisation. The "structural power of matter" must therefore, in his estimation, be both a quality inherent to matter and a quality that abides by the principle of continuity throughout time—from the deep past through into the far reaches of the future.[164]

Thus far, it seems that Tyndall's understanding of intensive power is at odds with Thomson's thermodynamic calculations. Certainly, Tyndall attempted tacitly to convince his readers that deep geological time was an incontrovertible fact. "It is now generally admitted," he says in 'Science and Man', published in *The Fortnightly Review* in 1877, "that the man of to-day is the child and product of incalculable antecedent time."[165] (By whom this is 'generally admitted' is not specified). Yet Tyndall's professed

[163] Tyndall, *Address*, p. 55.
[164] Ibid., p. 56.
[165] Tyndall, 'Science and Man', p. 594.

belief in "the continuity of Nature" echoes his preceding claim in the Belfast lecture that thermodynamic theory provides the greatest theoretical generalisation of energy yet conceived. How then, does Tyndall align these statements with his more abstract theorisations of intensive power operating through deep geological time? In 'Science and Man' we are offered an insight into the poetic contrivance on which this reconciliation hinges, through Tyndall's recourse to mythological heritage and Carlyle's natural supernaturalism.

Focussing on humanity's intensive historical construction through time, Tyndall writes in the essay: "His physical and intellectual textures have been woven for him during his passage through phases of history and forms of existence which lead the mind back to an abysmal past."[166] If the 'abysmal' past of Tyndall's incalculable time is intended here to evoke a vertiginous and terrifying verticality absent from Thomson's conservative figures, then the "textures" "woven" through it invoke a Carlylean sense of power lurking beneath nature's emblematic clothing. Those familiar with Tyndall's work may have recognised the echo of similarly Carlylean lines spoken at Belfast. Man "carries with him the physical texture of his ancestry"; the numinous is not a nebulously transcendental Truth, but "woven into the texture of man"; Nature's "Power" manifests itself as a "garment … seen in the visible universe".[167] In fact, Tyndall was using this metaphor in his lectures prior to Belfast. His 1870 address to the BAAS at Liverpool argued for the ethical vitality and scientific validity of a universe in which spirit and matter are woven together as "faces of the self-same mystery". Look at matter, he implored his audience, "not as brute matter, but as 'the living garment of God'".[168] Similar references in 'Science and Man' to a universe woven by immanent material powers are soon made explicit:

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166 Ibid., p. 594.
167 Tyndall, *Address*, p. 50; 60; 58.
168 Tyndall, 'Scientific Use', p. 36.

Robert Boyle regarded the universe as a machine; Mr Carlyle prefers regarding it as a tree. He loves the image of the umbrageous Igdrasil better than that of the Strasburg clock. A machine may be defined as an organism with life and direction outside; a tree may be defined as an organism with life and direction within. In the light of these definitions, I close with the conception of Carlyle. The order and energy of the universe I hold to be inherent, and not imposed from without.[169]

Igdrasil, the Norse "ash-tree of existence," was a favoured image of Carlyle's. Its form constantly changing, the tree was a conceptual contrast to the universal clock (or by association, Paley's fabled watch). While the clock is concerned with the present yet nevertheless winds down towards increasing entropy, Igdrasil "is the past, the present and the future; what was done, what is doing, what will be done; 'the infinite conjugation of the verb *to do*.'"[170] Like non-finite verbs, the Norse tree is not subject dependent; nor is it constrained to a linear temporal mode. Rather, it stands as a symbol for cosmic connectedness and internal organisation, where Nature's material garments and adornments reach through 'abysmal' time.

Moreover, the spatial orientation of Igdrasil extends beyond the vertical: its branches and the "histories of nations" embedded in its connective fibres, unfold and grow laterally as well as vertically.[171] By definition, to be "umbrageous", as Tyndall describes the tree, is to imply coverage, its form necessarily blooming outward in all directions. Although the tree was the god Odin's gallows, its spatiotemporal form thus follows the etymological root of Odin. Odin, or *Wuotan*, Carlyle notes, "connects itself … with the Latin *vadere*, with the English *wade*" and "means primarily *movement*, source of movement, power … force of *movement*" [emphasis original].[172] Drawing on this mythological heritage—and the notions of continuous lateral movement and the lack of boundaries and discrete components, as opposed to the interlocking gears of a watch—Tyndall presents an image of the universe spreading out in all directions

[169] Tyndall, 'Science and Man', p. 595.
[170] Thomas Carlyle, 'Lecture I: Hero as Divinity. Odin – Paganism – Scandinavian Mythology' in *The Best Known Works of Thomas Carlyle*, (New York: The Book League of America, 1942), pp. 159-83 (p. 171).
[171] Ibid., p. 171.
[172] Ibid., p. 173.

through deep time. It is an image remarkably different from a mechanical cosmos, deterministically regulated like a clock, set in motion by an outside agent and doomed to entropic disorder. Vadere: to go, to wander, to grow; the hallmarks of a machine that has its own internal power to drive processes of change "from their prepotent elements in the immeasurable past."[173] The clock universe, meanwhile, 'goes' but doesn't wander: "once set in Motion, it pursues the design of the Artist".[174]

Tyndall continues. As leaves and branches die, new buds spring in their place. The energy at work here is thermodynamic, but not pessimistic; nor does it necessarily imply a moment of divine origin leading to a certain end (entropy implies that time flows linearly). Still, Tyndall's poetic interpretation of thermodynamic time emphasises the first law (conservation) while downplaying the second law (entropy), recasting loss as *transformation*:[175]

> This doctrine recognises in the material universe a constant sum of power ... It is as if the body of Nature were alive, the thrill and interchange of its energies resembling those of an organism. The parts of the 'stupendous whole' shift and change, augment and diminish, appear and disappear, while the total of which they are the parts remains quantitatively immutable.[176]

Quantitatively immutable, but not qualitatively. To demonstrate this distinction, Tyndall returns to perhaps his most favoured conceptual realm: the molecular. He tracks particles of ocean water on their hydrologic cycle, from sea to air to land, through the breaking apart of distinct molecules to their re-condensation. The mechanical work required to perform these transformations appears to have "disappeared from the universe." But of course, no "particle of vapour was formed and lifted without being paid for in the currency of solar heat", just as any particular expenditure of work also demands the necessary 'loss' of energy in the form of heat

[173] Tyndall, *Address*, p. 58
[174] Robert Boyle, *The Theological Works of the Honourable Robert Boyle,* ed Richard Boulton (London: W. Taylor, 1715), p. 83.
[175] Tyndall's even more speculative interpretation of thermodynamics in *Heat a Mode of Motion* is discussed in greater detail in the following chapter.
[176] 'Science and Man', p. 597.

transfer.[177] These observations were nothing new: by the time of Tyndall's essay, 1877, the laws of thermodynamics had been widely consolidated. The intervention Tyndall makes, however, is to explicitly ally these concepts to geological and biological processes *and* the organic mythological machine of Igdrasil. Thus, Tyndall's poetically informed ontology completely restructures time and space. It is predicated on cyclical deep time (as in the cyclical process of hydrological change and the Norse tree's simultaneity of past, present and future), and a material power, a *vis viva*, that is woven into the fabric of matter. It was a view that is hard to imagine Tyndall reaching without his embodied dualistic and duelistic encounters with the immense material power and abysmal deep time of the Alps.

1.6 Conclusion: Tyndall's intensive materialism

Though the nonhuman materialist ontology presented here is explicated through myth, poetry, and other devices intended to force his readers to think outside of comfortable bounds, it was formed primarily through Tyndall's mountaineering adventures. The Alpine landscape had a profound affect on Tyndall. As Reidy and I have argued, it produced in his science a shift to 'verticality'. Moreover, verticality began to affect Tyndall's language and metaphorical expressions: from figurative depictions of the progress of science, to claims of the ethical, physical and intellectual value of muscular exertion and individual masculinity. As this chapter has argued, these narratives are not without their problems. Their combative and self-aggrandising qualities sit uneasily next to Tyndall's moments of reflective insight and his growing conviction of what he perceived as an intensive power immanent to matter. There is no easy way to reconcile these differences. But they are perhaps to be expected given that Tyndall's materialism was predicated on embodied experimentation.

[177] Ibid., p. 598.

Indeed, joining with nature in dualistic encounters, Tyndall channelled the romantic sensibilities of the poetic sublime, affirming the power of the numinous to affect the aesthetic, sensory, emotive *and* scientific faculties. In climbing, Tyndall enacted a form of corporeal elasticity and deterritorialisation, in which his body, mind and senses were deformed, squeezed and stretched. For Tyndall, "[t]earing the consciousness away from the subject in order to make it a means of exploration" was essential to an ethical materialist life and real scientific inquiry.[178] On a few occasions, he was nearly overpowered by these embodied encounters. But, as Tyndall always believed, "'No man knows the force of water …until he has experienced a storm at sea.'"[179]

This chapter has implied throughout that most Victorian critics misunderstood Tyndall's materialism, while modern scholars, recognising its uniqueness, have figured its idiosyncrasies in a number of invigorating ways. Nonetheless, to label Tyndall a pantheist, as Ruth Barton does, is to do his ideas a disservice. Tyndall was certainly influenced by pantheists such as Spinoza and Bacon and viewed the world in ways that approached their monist metaphysics. But Tyndall used language with precision. In his public debates, lectures and written works, he clearly stated he was a materialist, contrasting his position with pantheism. The problem for Tyndall was that his materialism confounded his contemporaries.

And while Tyndall used myth and poetry to explain and reformulate time, matter and power, these descriptions were themselves sometimes problematic. Occasionally they cut the tethers of evidence and fact entirely and let imaginative speculation float off into the ether. This was a practice not limited to Tyndall. Other Victorian scientists also began to find that transferring the strange world of energy physics into logical laws, prose, analogies and mathematics was more fraught than they first realised. Indeed, thermodynamics had started to pose some worrying implications

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[178] Deleuze and Guattari, *Thousand Plateaus*, p. 177.
[179] Tyndall, quoting a sea captain with whom he was caught in a powerful sea storm in 1870. *Hours*, p. 432.

threatening the integrity of religion, the rationality of science and the very future of human existence. In response to these problems, scientists began to twist thermodynamic ideas to fit their own ideological narratives. Seeking both to overturn the *mechanical* inevitability of entropy, and, paradoxically, at the same time using entropy *analogically*, these narratives were often confused, convoluted and obscure. Sometimes, they also inadvertently reaffirmed matter's recalcitrance. But they were, undeniably, popular. Something about thermodynamics and its resonance with cultural anxieties ignited the public imagination. It is these thermodynamic narratives that are the subject of the following chapter.

CHAPTER TWO

Entropy, information and analogies part I: eternal universes and degraded texts

"Once I got home, I sulked for a while. All my brilliant plans foiled by thermodynamics. Damn you, Entropy!"
—Mark Watney, stranded Martian astronaut[1]

Introduction: Law and order

When Albert Einstein claimed that God did not play dice with the universe he was met with the following response from fellow physicist Niels Bohr: "Stop telling God what to do!" But Einstein could not help it; he was troubled by quantum mechanics. The theory was profoundly counterintuitive. Its description of the wave-particle duality of subatomic matter was at odds with the smooth, contiguous spacetime postulated by relativity. The problem was that both sets of theories worked in their own right. Taken separately, they described real physical phenomena with unwavering precision. Yet Einstein refused to believe that the absurdities of quantum mechanics accurately represented reality. It simply made no sense.

Einstein's reluctance to accept quantum mechanics encapsulates a problem pondered by many nineteenth-century scientists and philosophers: could mentally constructed hypotheses represent the actual conditions of matter? Could a natural law be inferred from observed regularity? Or, as David Hume suggested, are causal relations between objects merely a phenomenological projection of idealised

[1] Andy Weir, *The Martian* (New York: Random House, 2014), p. 72.

properties? These were questions fraught with complexities. But by the latter half of the century, many physicists thought they had indeed found such stability in the two laws of thermodynamics. With these laws, Victorians did not need to tell God what to do. They already knew his plans.

The study of the relations between the heat, work and energy of a system, thermodynamics was a towering achievement of Victorian science; by the 1860s, William Thomson and the German physicist Rudolf Clausius had consolidated its two fundamental laws. The first said that energy could neither be created nor destroyed. Though it could be changed into different forms, the total energy of the universe stayed the same. On the other hand, the second law said that the entropy (a measure of disorder) of a system would increase over time. This was the caveat to the first law. Energy does not technically disappear but it cannot be put to further use once it has degraded. For each amount of mechanical work performed, a small cosmic deposit is made in the form of waste heat. As the science fiction writer Robert A. Heinlein put it, 'There Ain't No Such Thing As A Free Lunch.'[2]

For a while, these laws were considered immutable. They governed the thermal operations of the universe and gave it a temporal direction. Many also saw them as evidence of divine creation: the universe had a beginning and would come to an end. In a draft manuscript for a series of papers on dynamical heat, Thomson concluded that only God had the power to change these laws: "no destruction of energy can take place in the material world without an act of power possessed only by the supreme ruler".[3] Even so, Victorians began to ponder questions of reversibility, directionality, flow and waste as efforts to find increasingly efficient heat engines became one of the foremost

[2] Chapter title in Robert A. Heinlein, *The Moon Is A Harsh Mistress* (New York: Orb Books, 1966).

[3] William Thomson, draft manuscript of four papers 'On the Dynamical Theory of Heat' published between 1851 and 1855. As quoted in Crosbie Smith and M. Norton Wise, *Energy and Empire: A Biographical Study of Lord Kelvin* (Cambridge: Cambridge University Press, 1989), p. 329.

engineering objectives.[4] If the laws of thermodynamics could not be broken, they could still surely be bent.

This and the following chapter explore the strange narratives constructed in response to the implications posed by thermodynamics. As entropy and conservation became topics of discussion in the parlour as well as the laboratory, thermodynamic concepts began to mutate, taking on new and varied analogical functions. For example, the natural semantic proximity between thermodynamic dissipation and older notions of moral decrepitude made for pervasive and easy translations between the two domains. In an 1870 article decrying the 'Intellectual Dissipation' of the nation, flavour-of-the-month topics are figured as acting like ravenous heat sinks, diverting social energy away from matters of importance.[5] Such a "tremulous *waste* of energy" generates "an excess of heat in the intellect"; "Mr Ruskin's intellect, for instance, always seems to us to be in a chronic state of dissipation, so enormous a proportion of heat does it give out for any modicum of clear intellectual or moral result".[6] Hence, in the social world there also exists

> a real dissipation of energy,—a diversion of it from themes on which it is not thrown away, to one which, though of greater immediate interest, absorbs a vast deal of otherwise available intellectual energy, which is in consequence never turned to any satisfactory account at all.[7]

Yet entropy and conservation were also problematic concepts for the Victorians, and were not so easily assimilated into social discourses. For Christians, entropy had theological implications. Because it gave a temporal direction to the universe, it implied the cosmos had a beginning and end in time. Many saw this as proof of a divine creative act ensuring the promise of salvation in the future. At the same time, however, these same Christians had to contend with the fact that the entropic universe they observed

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[4] William Thomson, for example, delivered a lecture to the Royal Society of Edinburgh in 1874 titled 'On the Reversibility of Motion'.
[5] Anon., 'Intellectual Dissipation', *The Spectator*, 43 (1870), 973-74.
[6] Ibid., p. 974.
[7] Ibid.

was abundantly wasteful. If so much matter and energy had been expended in bringing the human race into existence, did this not imply a God who was incompetent, capricious and profligate? And, if the universe was heading toward destruction, was immortality still possible?

Thermodynamic physics thus maintained an uneasy relationship to personal, theological and ideological beliefs. Indeed, the laws themselves were met with suspicion from non-physicists, due to their apparently paradoxical nature. As one commentator in the *Quarterly Review* put it: "The supporters of the theory of the 'Dissipation of Energy' are also believers in that of its Conservation. To ourselves, the two theories appear to be inconsistent."[8] Such confusion regarding the basic tenets of thermodynamics fuelled wider anxieties about degeneration. After William Thomson's popularisation of thermodynamics in the 1850s, the laws started to become inextricable from the ways in which they were presented. Entropy and conservation were more than simply theories: their associated technical terminology was assimilated into cultural nomenclature and their energetic tendencies shaped the formal qualities of texts. It was not simply the laws of thermodynamics that were transformed. The texts these chapters discuss were also affected, to the extent that they too might become entropic, conservative, or even *negentropic*.

Sometimes, this playing out of thermodynamic effects within, on and across texts was intentional. Writers, aware that the cultural value of the information they were presenting was at stake, actively engaged in *en-troping*. This term is used to describe a range of interpretative strategies whose function was to prevent the degradation of ideas and provide epistemological stability in a climate of conceptual transformation. My use of the word yokes together the scientific notions of disorder with entropy's Greek etymological root, *trope*. As outlined in the Introduction, the word translates as *turn* or *transformation* to suggest that both matter and language

[8] 'Familiar Lectures on Scientific Subjects', *London Quarterly Review*, 36:71 (1871), 266-309 (pp. 306-07).

have the power to change, alter, and differentiate. The notion of entroping thus follows Rudolf Clausius' coining of the term.[9]

Analogical thinking played a central role in Victorian thermodynamics' development and its subsequent life in speculative texts: unsurprising, given that analogies also deal with the transformation of information. In the context of Victorian physics, the majority of work on analogies has tended to focus on those that deal with relations between physical systems and mathematics.[10] I propose, however, that Victorian scientists and writers, in the construction of their 'entroped' narratives, transformed thermodynamic ideas by shifting them away from purely mathematical descriptions of mechanical tendencies and into imaginative domains. As such, these analogies, functioning outside a strict rational framework, were unstable and messy; sometimes they resulted in disanalogies and the reduction of meaning, at other times they functioned as engines of conceptual novelty.

To analyse these various thermodynamic analogies, this chapter begins by defining some of the formal and operational components common to analogies. This definition combines Deleuze's critique of analogical thinking with other recent analyses from linguistics, philosophy and cognitive science to find commonalities between disciplines. For Deleuze, analogy is one of "the four shackles of mediation" that imprison thought within representational limits.[11] Over the next two chapters, Deleuze's view that analogy distorts material reality is used to frame the discussion of Victorian thermodynamic analogies. However, the two chapters present both the strengths and limitations of this construct, responding ambivalently to Deleuze's

[9] In 1865, Clausius united the terms 'heat loss', 'dissipation', 'degradation' and 'equivalence-value' under the neologism 'entropy', derived "from the Greek word *τρόπος, transformation*. I have intentionally formed the word *entropy* as to be as similar as possible to the word *energy*; for the two magnitudes denoted by these words are so nearly allied in their physical meanings". Clausius, *The Mechanical Theory of Heat*, trans T. A. Hirst (London: John Van Voorst, 1872), p. 357.

[10] In 1966, Mary Hesse argued that analogies are not merely decorative or explanatory but "buildable, picturable, imaginable" systems that are "logically essential" for "making a theory *predictive* [emphasis original]." Mary Hesse, *Models and Analogies in Science* (Notre Dame, IN: University of Notre Dame Press, 1966), p. 19.

[11] Deleuze, *Difference*, p. 38.

critique. This chapter contrasts the speculative theological physics of Balfour Stewart, Norman Lockyer and P. G. Tait with the productivist fantasies of Tyndall. Although these men were driven by opposing aims—Stewart, Lockyer and Tait envisaged a physical universe that ultimately answered to God, Tyndall imagined one that was self-sufficient and controlled by humans—their analogical speculations bear strikingly similar hallmarks. Indeed, all were united in the quest to find a source of limitless energy that could ensure the preservation of the human race throughout time. Tait and Stewart's *The Unseen Universe* (1875) sought cosmic salvation in the spiritual; Tyndall's paean to boundless energy in *Heat: A Mode of Motion* (1863) sought cosmic conservation in the material. In their attempts to ground anti-entropic narratives in the precepts and language of thermodynamic science, these scientific fables in fact suffused their texts with entropic sensibilities.

Chapter Three, meanwhile, explores the analogical thought of James Clerk Maxwell and his poetic anticipation of modern information entropy. More than any other physicist of his time, Maxwell saw the potential for theoretical models to produce novel ideas. While my argument draws from modern work analysing his mathematical analogies, it also shows how Maxwell approached thermodynamic problems by intersecting the scientific with the poetic and mythical—in particular, John Milton's *Paradise Lost*.

2.1 The structure of analogies

"A question about analogy", writes Peter Dillard, "is whether it has a real basis or is merely a human projection."[12] This is a harder question to approach than at first seems. Are all analogies the same? What constitutes an analogy?—structural similarity between objects; contiguity of relations; ease of cognitive translation; illustration or explanation? What about the difference between literary and scientific analogies: can one have a 'real' basis while the other does not?

In *Difference and Repetition* (1968), Deleuze defines analogy as "the relation between ultimate *determinable* concepts"—the things being compared[13]. Analogy sets the upper and lower equivalency of these concepts; their relations must be proportional and function within the bounds of common sense. Hence:

> [analogy] calls upon the power of distribution present in judgement. As for the object of the concept, in itself or in relation to other objects, it relies upon resemblance as a requirement of perceptual continuity. … [Each of these elements are] established across different faculties within the context of a given common sense … The 'I think' is the most general principle of representation—in other words, the source of these elements and of the unity of all these faculties: I conceive, I judge, I imagine, I remember and I perceive—as though these were the four [sic] branches of the Cogito.[14]

In this passage, Deleuze discerns three structural components that are characteristic of analogies. First, *interiority:* analogical meaning is dependent upon, and situated by, correspondences between internal concepts. Second, *ontological continuity:* analogical meaning remains largely consistent, unified and continuous, owing to the (supposed) structural continuities between material things (here, continuity denotes that these relations are repeated, linear, contiguous, stable, and logical). Third, *perceptual*

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[12] Peter S. Dillard, *Heidegger and Philosophical Atheology: A Neo-Scholastic Critique* (London: Continuum, 2008), p. 167.
[13] Deleuze, *Difference*, p. 37.
[14] Ibid., p. 174.

continuity: analogical meaning is anchored by the phenomenal subject's ability to make rational judgements.

The first principle, interiority, says that analogies are self-contained; they constitute a mapping between two or more things in a closed system. The things being compared, however, are not themselves necessarily similar. If they are, the analogy will fail. Rather, as Maxwell writes, analogy rests upon a "similarity between relations, not a similarity between the things related."[15] As such, meaning is dependent upon these initial concepts and does not suggest further tangential information: "the relation of each category … is interior to each category".[16] Paul Ricoeur, echoing Deleuze, also describes the comparative aspect of analogy as being defined by groundedness, stasis, and interiority. "The analogy," he writes,

> is a relation *adhering to its terms*. I am carried by the first meaning, directed by it, toward the second meaning; the symbolic meaning is constituted in and through the literal meaning which achieves the analogy by giving the analogue [emphasis mine].[17]

Similarly, psychologist Dedre Gentner argues that an analogy's meaning is dependent on its parts: "an analogy is an assertion that a relational structure that normally applies in one domain can be applied in another domain."[18] As such, analogy "defines a mapping from *B* to *T*", where T stands for "the *target*, since it is the domain being explicated" while B is "the *base* … the domain that serves as a source of knowledge."[19] Analogical mapping thus involves finding "*functional counterparts*

[15] Maxwell, *Elementary Treatise on Electricity*, ed. William Garnett (Oxford: The Clarendon Press, 1881), p. 52.
[16] Deleuze, *Difference*, p. 85
[17] Paul Ricoeur, *Freud and Philosophy: An Essay on Interpretation*, trans. Denis Savage (New Haven: Yale University Press, 1970), p. 17.
[18] Dedre Gentner, 'Structure-Mapping: A Theoretical Framework for Analogy', *Cognitive Science*, 7 (1983), 155-70 (p. 156).
[19] Ibid., p. 158.

between concepts".[20] To help her readers visualise this structure, Gentner provides a simple equation:

$$M{:}b_i \rightarrow t_i$$

Here, M = 'mapping', while b and t = 'base' and 'target' respectively.[21] It should be noted that the arrow in the equation does not confer a unidirectional process of analogical mapping. Rather, it suggests that the base domain is "the richer one from which knowledge can be imported to the retrieving [target] item."[22] Thus, the equation describes the most dominant form of transformation across internal terms. For this transference to take place, the base domain and its proportional relation to the target must be easily grasped, widely understood and/or largely free from interpretative ambiguity. The sun, for example, has been used as an analogy to God(s) in cultures throughout history because it powers organic life, provides light and heat and is steadfast. Or consider the following analogy used in 1866 to explain the transmission of telegraphic messages: "Imagine that the telegraph is an immense long dog—so long that its head is at Vienna and its tail is at Paris. Well, tread on its tail, which is at Paris, and it will bark at Vienna".[23]

In both instances Gentner's structure holds true and shows that analogy is often comprised of stable and internally cohesive terms. Following from this are two further assumptions: that both thought and matter are continuous, common sensical and rational. For Deleuze, analogies work the way they do because they rely on the mind to make rational judgements. Because it is grounded phenomenologically, the "relations

[20] Eric Dietrich, 'Analogy and Conceptual Change, or You can't step into the same mind twice' in *Cognitive Dynamics: Conceptual change in humans and machines*, eds. E. Dietrich and A. Markman (Mahwah: Lawrence Erlbaum Associates, 2000), pp. 265-94 (p. 268).
[21] The subscript *i* stands for "object nodes" that can or can not be relationally matched between the base and target domains. In Deleuze's work, they are the determinable general and particular limits of concepts that dictate the limits of analogical meaning. Gentner, 'Structure-Mapping', p. 158.
[22] Dietrich, 'Analogy', p. 7.
[23] Anon, 'A Novel Illustration of the Telegraph', *Providence Evening Press*, 31 August 1866, p. 2.

of analogy … are determined by a direct perception of *resemblances*, which suppose a continuity of sensible intuition in the concrete representation."[24] Analogy, for Deleuze, thus assumes priority of the Cogito. Because the sense data we receive on a quotidian basis is intelligible (e.g., objects can be differentiated, colours appear as distinct, the body is oriented in three dimensional space, time flows perceptibly) it assumes that the material world is too—that it follows, in other words, the same internal laws as our consciousness. Consequently, mind is positioned above matter while Being is underwritten by the most primary, but fallacious analogy of all: that there is an all-pervading principle of continuity between subject and object. Deleuze thus argues that analogy provides an inappropriate framework for thinking about the world because it is located in the 'common sense' of the phenomenally grounded subject.

Deleuze's critique assumes that analogy reinforces the notion that things and thought have distinct identities. Analogies reproduce what is already known or further degrade experience, sensation and thought. Without explicitly saying so, Deleuze is considering analogies in thermodynamic terms. He is concerned with how information is transformed into something less usable. Analogies perform their 'work' by establishing a flow of information between two domains. Gentner's structure mapping equation most clearly elucidates this resemblance. The base domain in her analogical model acts as the source from which the more highly ordered, 'energetic' form of information flows to the target domain, or sink. The movement from the recognisable and resonant base domain to the less well-understood target domain creates a new comparative idea (the analogy's 'work').

This description of analogy, along with its implicit assumptions about mind and matter, are rife in nineteenth-century popularisations of thermodynamics. Indeed, analogies are used to explain tricky scientific concepts by comparing, for example, mechanical energy to social, political or personal energy. However, what is perhaps more noteworthy is how the scientific, once explicated, is then transformed from the

[24] Deleuze, *Difference*, p. 43.

target to base domain. This is especially true in nineteenth-century attempts to use entropy as a concept to make speculative, non-scientific assertions.

The thermodynamic narratives discussed in this chapter can be split into two camps. For the Christian physicists Norman Lockyer, Balfour Stewart and P. G. Tait, entropy is a blessing and a curse. Although it suggests for them a divine creative act in time, they also have to account for how the soul is delivered from material dissipation. For Tyndall, entropy is problematic precisely because of its creative implications. As such, Tyndall attempts to circumvent entropy altogether, promoting instead (as we also saw in the previous chapter) a universe defined by cyclical time and boundless energy.

2.2 Stewart and Lockyer's delicately constructed cosmos

By the mid 1860s, the Victorian public was being increasingly exposed to thermodynamic ideas as heat, energy, waste and dissipation began to appear in popular periodical literature. In an 1869 issue of the popular weekly *Bow Bells*, an article describing the ubiquity of heat appeared alongside pieces about fashion, embroidery, household advice and travel.[25] "In much of our ordinary language," the article claimed, "the ideas of the dependence of life upon heat is embodied: ... 'vital spark,' 'lamp of life,' 'fire of genius,' are expressions in which literal truth and poetic imagery are remarkably combined."[26] But the article also raised the spectre of dissipation. Without heat, the world would be rendered "motionless and inert." The worrying notion of heat death had been in cultural circulation for a while. Thomson's 1852 paper 'On a Universal Tendency in Nature to the Dissipation of Mechanical Energy', had painted an apocalyptic vision of the end of the world.[27] Dissipation and degradation thus took on

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[25] *Dictionary of Nineteenth-Century Journalism in Great Britain and Ireland*, eds., Blake, Laurel and Marysa Demoor (London: Academia Press, 2009), p. 67.

[26] 'The Influence of Heat', *Bow Bells*, 10, (1869), 40. *Bow Bells*, subtitled, *A Magazine of General Literature and Art for Family Reading*, was a popular weekly publication, aimed at lower-middle class readers.

[27] William Thomson, *Mathematical and Physical Papers*, 6 vols (Cambridge: Cambridge University Press, 1882), I, pp. 511-14.

cultural meanings that allied older notions of wastefulness with their newer thermodynamic context. This was no happy accident. Scientists and writers saw the latent potential of thermodynamic narratives but were quick to bolt on their own interpretations of what heat death could mean for their specific ideologies. As Crosbie Smith notes, for many Victorians, "dissipation of energy ... linked together the natural and moral orders."[28]

Dissipation's moral registers had been in circulation since the seventeenth century. Understood as wasteful expenditure of means, money or property, dissipation, by the eighteenth century, had also come to refer to distractions of "the mental faculties or energies from concentration on serious subjects" and the "frittering away of energies upon frivolities".[29] For Thomson, "dissipation was a waste of energy to man" as well as a waste in nature."[30] As Barri Gold notes, dissipation "carried moral connotations to William Thomson long before he adopted it to describe the progress of the physical universe," after his father used the term in a letter to describe "a certain Glasgow student who had 'been indulging in the habits of dissipation.'"[31] It is only later in his career that more recent thermodynamic associations of dissipation are yoked to its older moralistic meanings. This move is followed by many of Thomson's colleagues and contemporaries. And in combination with the still uncertain term 'energy'—a word that for non-scientists also denoted qualities of character and inner power—thermodynamic analogies soon began to populate popular scientific literature and speculative works of philosophy.

The apocalyptic consequences of the sun's dissipation are considered in an essay written by physicist Balfour Stewart and astronomer Norman Lockyer. For Stewart and Lockyer, the sun was an enduring source of fascination. A great cosmic engine powering a surrounding planetary system, it also provided a way to make

[28] Crosbie Smith, *The Science of Energy: A Cultural History of Energy Physics in Victorian Britain* (London: The Athlone Press, 1998), p. 240.
[29] "dissipation, n." *OED Online*. Oxford University Press, 28 December 2014.
[30] Smith, *Science of Energy*, p. 240.
[31] Gold*, ThermoPoetics*, p. 100.

thermodynamic ideas accessible to a lay audience. In the second part of 'The Sun as a Type of the Material Universe' (1868), energy physics is used as an analogical framework with which to discuss ideas belonging "to very different departments of knowledge"—a "community of type", as they term it.[32] Stewart had already published a number of articles connecting disparate branches of science to non-scientific questions.[33] Arthur Schuster, a student of Stewart's at Owen's College, claimed that his tutor had a particular habit of arguing by analogy.[34] This fondness for analogical reasoning extended beyond the classroom and into Stewart's texts, such as the "striking analogy between light and heat" presented in his book *Lessons in Elementary Physics* (1870).[35] But his collaboration with Lockyer, an astronomer who had developed the spectroscopic study of solar phenomena, placed ideas interweaving energy physics, speculative philosophy and literature in an even broader context.

The publication of their 'Sun' articles in *Macmillan's Magazine* saw them featured alongside serialised fiction, a review of George Eliot's *Spanish Gypsy*, and discussions about domestic and political issues. Stewart and Lockyer do their utmost to take advantage of this confluence of the literary, scientific and social. They begin by "insinuating an analogy" between potential and social energy: "if two men of equal personal energy contend together, the one who has the highest social position has the best chance of succeeding."[36] Likewise, a stone raised to a height above the ground has a measure of positional energy greater than a stone at a lower level. Nevertheless, they claim, a man "may degrade his energy" by engaging in dissipated activities.[37] Here, the

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32 Balfour Stewart and Norman Lockyer, 'The Sun as a Type of the Material Universe, Part II,' *Macmillan's Magazine*, 18 (1868), 319-27 (p. 319).

33 Stewart aimed to generate a wide popular audience for his theological interpretation of physics, publishing works in *Nature*, *Macmillan's*, alongside more specialised periodicals such as *North British Review*.

34 Arthur Schuster, *Biographical Fragments* (London: Macmillan, 1932), p. 213.

35 Balfour Stewart, *Lessons in Elementary Physics* (London: Macmillan and Co., 1873), p. 276.

36 Stewart and Lockyer, 'Sun II', p. 319.

37 *The Unseen Universe*, which is discussed in greater detail later in this chapter, contains a particularly haunting description of dissipated morality. "The dissipation of energy is a great fact in a moral as well as in a physical sense. ... creatures in the likeness of men vent their despicable passions in murderous assaults upon women and children." But, with almost sadistic glee, the authors envisage a solution: "science hints at an effectual cure. ... electricity ... will be called upon by an enlightened legislature to produce absolutely indescribable torture ... thrilling

'base' domain, the one that holds the greater explanatory power, is the social, which the authors use to familiarise their readers with basic energetic principles. It is not long, however, before the newly explicated realm of energy is itself used to describe the cosmos' source of eternal power. The sun plays a prominent role in this analogy because of its connection to the earth. Its "energy is spent in producing the wood or the coal, and the energy of the wood or coal is spent … in warming our houses and driving our engines".[38] But this solar currency is also spent maintaining nature and as such, is a finite resource; with unerring inevitability, the sun and earth, and the universe as a whole, are doomed to eventual heat death. Yet the fact of entropy provides a scientific peg on which to hang an eschatological narrative. If the universe had a definitive beginning and will have a certain end, this implies both a moment of creation and potential salvation. Appealing to the tradition of natural theology, Stewart and Lockyer thus hold the heat-death hypothesis to be deeply engrained in the workings of the natural world and recognised by humans throughout history. "Long before any of these laws were known" they write, "the superiority of certain kinds of energy was instinctively recognised".[39]

Stewart and Lockyer see an instance of adumbrative thermodynamic knowledge in Walter Scott's 1805 poem, 'The Lay of the Last Minstrel': "That lamp shall burn unquenchably, / Until the eternal doom shall be."[40] They regard these lines as an instance of poetic insight expressing a long-standing tension in human history, where tales of the ever-burning lamp are offset by the underlying suspicion of such an object's physical impossibility. Long before the consolidation of thermodynamic laws, they write, quests for an eternal fuel were "associated with pretentions to magic". Nevertheless, the eternal lamp occupied a place in the Victorian imagination that conjoined the mythical and scientific, contemporary and ancient, homely and foreign.

through every fibre of the frame of such miscreants." Balfour Stewart and P. G. Tait, *The Unseen Universe, or Physical Speculations on a Future State*, 3rd edn (New York: Macmillan and Co., 1890), pp. 106-07.

38 Stewart and Lockyer, 'Sun II', p. 322.

39 Ibid.

40 Ibid.

"When we hear the word Lamp," claimed an article published in Dickens' *Household Words*, we recall "the Wonderful Lamp of Aladdin" or the oil lamps of biblical lore or "the torch of Hymen at the weddings of old Greece and Rome".[41] The myth of the eternal lamp built on these already heavily suggestive resonances by adding a flavour of mysterious authenticity. Perpetual lamps were supposedly found in Roman tombs, continually "burning without any waste" while "the idea of sepulchral lamps" created by skilled alchemical philosophers "from the East" offered a tempting fantastical alternative to Enlightenment science.[42] Meanwhile, accounts from sixteenth and seventeenth-century European sources claimed to be close to discovering the perfect combination of chemicals to create "a combustible fluid, which, while burning and giving out light, diminished not in quantity and potency."[43] And closer to home, Nathaniel Bailey wrote in his *English Dictionary* of 1730 that "in the time of King Henry VIII, there was a lamp found that had been burnt in a tomb from about three hundred years after Christ"—a curiosity that could supposedly "be seen in the Museum of Rarities at Leyden in Holland."[44]

Thermodynamic science adds another contradictory dimension to this myth. On one hand, the first law seems to promise that such an object is possible: a cosmos where energy abounds in perpetual supply and where "the nearest approach to an ever-burning lamp is the sun".[45] Energy, like matter, can never be destroyed. And coupled with the apparent "perpetual motion ... represented by the motion of the earth on its axis," the solar system appears to embody ever-lasting motion. The image Stewart and Lockyer sketch here is at once energetic and pastoral: "Windmills and watermills are ... due to the sun as well as steam-power and muscular energy."[46] Haunting this vision, however, is the spectre of the second law: the ghost that has always lurked behind

[41] 'Eternal Lamps', *Household Words*, 8 (1853), 185-88 (p. 185).
[42] Ibid., p. 185.
[43] Henry Carrington Bolton, *Legends of Sepulchral and Perpetual Lamps* (London: E. J. Davey, 1879), p. 4. Originally published in the *Monthly Journal of Science*, November 1879.
[44] 'Eternal Lamps', p. 186.
[45] Stewart and Lockyer, 'Sun II', p. 323.
[46] Ibid.

narratives of eternal lamps but that had only recently been consolidated scientifically. Like the lamp, the second law promises that Stewart and Lockyer's bountiful conservative vision is not exempt from mechanical degradation. Just as the sepulchral lamps of ancient mausoleums retain a curious link to the dead—they are, after all, symbolic markers of what is lost—the sun's store of energy will run out, its light and heat not lost but transformed into waste.

For Stewart and Lockyer, entropic certainty is more than a fatalistic condition of physical reality; it has deeper, theological resonances. Indeed, their interpretation of dissipation's inevitability puts a positive spin on nature's course; it holds for them spiritual value. Being inextricably bound to a temporal trajectory means the cosmos had a beginning in time and will come to an end. This fact alone implies for the authors both a moment of creation and a moment of salvation. The sun's light and heat will burn away unless "energy of a superior form be communicated from without."[47] Such energy "from without" is, in their view, immaterial, and thus Stewart and Lockyer defer the ultimate source of energy to the divine. "We suppose", they write, "that a Supreme Intelligence, without interfering with the ordinary laws of matter, pervades the universe, exercising a directive energy".[48] Of course, divine intervention does not merely override the material degeneration of the cosmos. It also rescues humanity from its own dissipated habits.

Stewart and Lockyer's notion of 'directive' energy is developed alongside their belief that nature is characterised by "a delicacy of construction".[49] This principle proposes two interrelated ontological properties of matter that the authors then extend analogically to immaterial forms. First, there are unstable yet finely balanced connections between things; and second, these connections, even if they are miniscule or separated by vast removes, have the capacity to cause exponentially greater effects. For example, pulling the trigger of a gun—"an exceedingly small primordial impulse"—

[47] Ibid., p. 324.
[48] Ibid., p. 327.
[49] Ibid.

produces "great and visible results".[50] Systems such as these, characterised by instability and/or incalculability, are delicately constructed "machines." For the authors, the human being is an organic variant of such a machine—"an organisation of infinite delicacy". Crucially, a human being has the capacity to use "an infinitely small amount of directive energy" upon matter to "bring about perceptible results."[51] The human-machine thus has the capacity to affect matter external to itself. But it is also capable of converting an imperceptible mental decision into an exponentially greater physical action.

Cause and effect, instability and incalculability: these characteristics of living beings are analogous to the material operations of the solar system. Though separated by millions of miles, the sun is directly connected to earth: "solar disturbances appear to be accompanied by disturbance of the earth's magnetism" while "sun spots" have a direct "connexion" to "the meteorology of our globe". More than physically deterministic, this "connexion" is profoundly intimate: "they feel together, they throb together, they are pervaded by a principle of delicacy even as we are ourselves."[52] Cosmic lovers 'throbbing' across space, the sun and earth are macro types of the delicately constructed organic being. From here, Stewart and Lockyer shift the analogy one domain higher to the spiritual and immaterial. If the human and solar system are constituted by delicate connections—connections that are powerful but obscured—then is the same not true for the entire cosmos? For the authors, the universe does indeed have an unseen but powerful immaterial dimension. And what is more, like the body's relation to the mind, the material cosmos can be 'directed' from this spiritual domain—not through a violation of natural law but by the perturbation of energy.

Here, the analogy is characterised by the components previously discussed, namely interiority and continuity. Implicitly assuming an ontological continuity between different classes of beings and things—a principle that is then reincorporated

[50] Ibid., p. 326.
[51] Ibid.
[52] Ibid., p. 327.

back into its own conceptual structure—the analogy remains closed and unidirectional. Moreover, each analogical step in the argument extends the chain of inference until it reaches the spiritual scale. First, the delicacy of the living being (base) is mapped onto solar and planetary interactions (target). After this, both domains are synthesised to create a new base domain of delicate material organisation that is used as an analogy for delicate immaterial and spiritual organisation. At all scales, the principle of organisational finesse obtains. Extending from the terrestrial to the celestial, the flow of information across exchanges thus remains linear and common sensical.

And still, the spectre of entropy lingers over the analogy. However hard Stewart and Lockyer try to make heat death fit within a unified cosmological plan, it remains obstinate to their designs. Indeed, the authors have to contend with the fact that at all scales—human, terrestrial, interstellar—their 'delicately constructed' cosmos is remarkably inefficient. It produces vast amounts of waste, both in moral and material terms. In "the social world there are forms of energy conducing to no useful result"; the energy stored in wood and coal is spent "far from economically"; and the heat produced by burning coal is "diffused or spread about," representing "the most degraded and worthless of all forms of energy."[53] Heat, it seems, 'throbs and feels' with our wasteful and capricious habits too. What orderly creator would create a system so abundantly wasteful, so brilliantly inefficient, and programmed to become increasingly dissipated? How is this compatible with a principle of continuity and delicate construction? Can free will really exist in a universe whose death looms on the horizon and where resources deplete exponentially? They are questions that Stewart and Lockyer are keen to avoid, along with the physical evidence for their claims that the universe is divinely directed. They conclude their essay by prevaricating: "we cannot venture to offer any further remark on this subject."[54] It would take a further seven years for Stewart to finally tackle these questions head on. When he did, it was with the audacity of a renegade. Or possibly a madman.

[53] Stewart and Lockyer, 'Sun II', p. 322.
[54] Ibid., p. 327.

2.3 Entropic eschatology in *The Unseen Universe*

In 1875, less than a year after Tyndall's Belfast speech, *The Unseen Universe* was published. The book was an instant success and by the late 1880s it had been through fourteen editions. It was also highly contentious, plagued by accusations of scientism, suspect metaphysics and theological distortions. Its authors initially chose to remain anonymous though their identities soon became an open secret: one was Stewart, the other was P. G. Tait. Like the 'Sun' articles, *The Unseen Universe* attempted to merge energy physics with metaphysics and provide a counter narrative to the materialist propositions of Tyndall's address. According to the authors, the scientific "dogmatists" were guilty of "closing the door leading from the seen to the unseen": a door that Tait and Stewart "resolutely maintain … must be left open."[55] Even so, before this door can be left open, Stewart and Tait have to first open it in a way that convinces. And how they do this is intimately bound with the problems complicating the earlier attempts in Stewart and Lockyer's 'Sun' essay to render thermodynamics as a theological parable: How can dissipation be reconciled with an afterlife? Why is the 'delicately constructed' cosmos so intrinsically wasteful?

After a long (and rather dreary) exposition of thermodynamics and the history of religious thought, Stewart and Tait finally put these problem in clear terms:

> Can anything be more perplexing than this seemingly frightful expenditure of the very life and essence of the system? That this vast store of high-class energy should be doing nothing but travelling outwards in space at the rate of 188,000 miles per second is hardly conceivable.[56]

Curiously, although waste represents a theological problem for the authors, their language is at its most charged when describing the apocalyptic fate of the cosmos. The

[55] Stewart and Tait, *Unseen*, p. v. (This quotation is taken from the 'Preface to the 3rd edition', as it appears in the third edition of 1875. The book went through numerous editions within its first few years of publication. I refer to this edition as, barring a few corrections and grammatical changes, the main content remains almost identical to the first edition, with the added benefit of further prefaces responding to the book's reception.)
[56] Ibid., p. 156.

"earth and the other planets of our system will be drawn spirally nearer and nearer to the sun, and will at length be engulfed in his mass". "[T]here will be ... mighty catastrophes due to the crashing together of defunct suns—the smashing of the greater part of each into nebulous dust surrounding the remainder, which will form an intensely heated nucleus," ultimately resulting in "the inevitable destruction of the visible universe."[57]

In spite of entropy's sensationalist appeal, dissipation is a problem for two reasons. First, Stewart and Tait have to figure out a way in which the soul might be able to escape the clutches of the second law and be transmitted into the 'unseen', divine realm of God. Second, entropy sits uneasily next to Stewart and Tait's belief in what they term, the 'principle of Continuity'. This principle rejects the suggestion that scientific theories are contradictory and separated by conceptual revolutions. Rather, old theories are furnished with greater explanatory detail resulting in greater approximations of the truth. As such, the operations of thought are governed by intelligible order and will continue to do so into the future: "[the] Principle of Continuity ... underlies ... all scientific enquiry".[58] For Stewart and Tait, the regulatory action performed by this principle validates their forthcoming explanation of the soul's immortality for two reasons: it ensures an equivalent perceptual continuity between themselves and other rational minds, thereby implying their analogies for the existence of the afterlife are grounded in a common phenomenological reality; and it confirms the handiwork of a benevolent divinity allowing them to locate their work in the tradition of natural theology. "[A]ssuming the existence of a Supreme Governor of the universe," they write, "the principle of Continuity" assures "that He will not put us to permanent intellectual confusion, and we can easily conceive similar expressions of trust with reference to the other faculties of man."[59] Tait had already made a similar argument in his *Treatise on Natural Philosophy*, co-written with Thomson in 1867.

[57] Stewart and Tait, *Unseen*, p. 91; 92; 156.
[58] Ibid., p. vi.
[59] Ibid., p. 60.

Matter, they wrote, is defined "as that which can be perceived by the senses".[60] This earlier statement of matter's intelligibility and *The Unseen Universe*'s principle of continuity, hark back to the rationalist assertion that God would not deliberately set out to cause confusion. Hence, predicated on the Newtonian conception of reason, their methodology reproduces divine truth and order.

Indeed, the principle of continuity constitutes an epistemological rejection of entropy. Instead of becoming more diffuse, Stewart and Tait claim, knowledge becomes increasingly ordered over time. For Deleuze, the idea of equivalence between the workings of different minds and the operations of Nature is one of the most fallacious analogies of all: it is a "transcendental illusion".[61] For Stewart and Tait, however, it constitutes a transcendental truth. More than a statement about the relation of laws to nature, the principle of continuity pervades the very material processes of reality. Indeed, as they themselves make clear, "our reasoning has been founded on the principle of Continuity *as applied to the Outward universe* [emphasis mine]."[62]But, as will become apparent, the central analogy of *The Unseen Universe* proposing to explain the conservation of the soul through eternal time will itself become degraded. Contrary to their principle of continuity, Stewart and Tait's theory ends up as little more than wasted words.

Having argued for the existence of epistemological continuity and the 'conservation of ideas,' Stewart and Tait set about explaining how the soul might resist entropy too. In searching for a cosmic mechanism to facilitate the "transmigration of souls" from the material to spiritual universe, they propose an analogy between the delicately constructed machine of the human being and the delicately constructed machine of the cosmos.[63] This was already outlined in the 'Sun' essay. Here, however, Stewart and Tait furnish the analogy with greater detail, focussing on the role memory

[60] P. G. Tait and William Thomson, *Treatise on Natural Philosophy*, 2 vols (Cambridge: Cambridge University Press, 1912), I, p. 219.
[61] Deleuze, *Difference*, p. 355.
[62] Stewart and Tait, *Unseen*, p. 176.
[63] Ibid., p. 28.

plays in situating humans in time. It is through a form of cosmic memory, the authors will argue, that spiritual entropy is circumvented. Every "thought that we think," Stewart and Tait claim, "is accompanied by certain molecular motions and displacements in the brain". Some of these motions "are stored up in that organ, so as to produce what may be termed our material or physical memory."[64] Memory, is the primary means by which the "individual [retains] a hold upon the past" while allowing simultaneously for "varied action in the present" and the potential to act in the future.[65] Memory, that is, records past experience and is used to inform decisions made in the present and future. But it also allows humans to remain connected to the past—to resist the loss of past events by retaining an impression of them in the mind.

Likewise, Stewart and Tait argue, "something analogous to an organ of memory must be possessed" by the universe: something which takes an impression of people's moral actions, beliefs, personality and thoughts—everything which constitutes their soul.[66] To many Victorian readers, it would come as little surprise that Stewart and Tait's organ of cosmological memory turns out to be the ether. It was a medium not only postulated as essential to the transmission of energy by nearly all Victorian physicists but also one whose plasticine form was capable of transporting all manner of undulatory emissions: from light and heat, to spirits, brain waves and auras. The ether's imponderability was not a problem for scientists and spiritualists. In fact, this enhanced its conceptual malleability: its capacity to be moulded to suit almost any purpose. No doubt aware of the ubiquity of the ether in spiritualist and pseudoscientific texts, Stewart and Tait attempt scientifically to ground their definition of it. But lacking any empirical evidence, they have to use analogy to justify first its existence and then its ability to transmit the soul from the physical to the unseen universe.

To demonstrate how the "apparently irreconcilable properties" of an ethereal medium are in fact materially consistent, Stewart and Tait adopt an analogy first

[64] Ibid., p. 200.
[65] Ibid., p. 177.
[66] Ibid., p. 52.

employed by George Stokes.[67] Like a solution of glue or jelly, the ether is capable of acting as both a fluid and elastic solid. As such, it can "be distorted as well as displaced by matter passing through it" and thus "has the power of transmitting motion from one part of the universe to another".[68] Indeed, a "picture of the sun may be said to be travelling through space with inconceivable velocity, and ... continual photographs of all occurrences are thus produced and retained."[69] The elastic, suprasensual ether functions therefore as both memory and transmitter, taking impressions of energetic transformations and distributing them throughout the cosmos and into an immaterial realm. Yet how can the ether perform this action if it is itself materially constituted? Is its own substance not subject to entropy?

In the 1850s, Thomson theorised that atoms, rather than hard incompressible spheres, could in fact be vortices. If the elastic continuum of the ether had properties similar to a perfect fluid, then vortical atoms within its substance would maintain their momentum for eternity. However, these ideas remained speculative; Thomson simply had no empirical evidence to back them up. Then, in 1867, he read a paper by Helmholtz that was translated by Tait and published in the *Philosophical Magazine*.[70] Helmholtz's paper made an astounding claim: a vortex in a perfect fluid was not subject to dissipation. The surrounding fluid, if free from viscosity would not alter its motion. It was, in other words, both elastic and eternal.[71] Tait expanded upon Helmholtz's theory by experimenting with smoke rings and showing the effect two or more rings colliding had on each other's properties. Thomson was gripped by these findings. He now had physical evidence showing that vortical motion and counter-entropy were united. Without hesitation, Thomson published his paper 'On Vortex Atoms' (1867).[72] It suggested that atoms, far from following the "monstrous assumption" that they are

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67 Ibid., p. 111.
68 Ibid., p. 111; 112.
69 Ibid., p. 156.
70 Hermann Von Helmholtz, 'On Integrals of the Hydrodynamic Equations That Correspond to Vortex Motions', trans P. G. Tait, *Phil. Mag.*, 4 (1867), 485-512.
71 William Berkson, *Fields of Force: The Development of a World View from Faraday to Einstein* (New York: Routledge, 1974), p. 259.
72 William Thomson, 'On Vortex Atoms', *Phil. Mag.*, 34 (1867), 15-24.

"infinitely strong and infinitely rigid pieces of matter", could be materially viable vortices.[73] Thomson's vortex atoms behaved much like Helmholtz's vortices in a perfect fluid: they were immune to destruction and the perfect fluid they occupied was envisaged as the continuous medium of the luminiferous ether. Thus, the propagation of energy through the ether could be considered as the transmission of action "along vortex filaments" filling the entirety of space.[74]

Stewart and Tait embrace this theory in *The Unseen Universe*, tweaking it slightly to fit their requirements. They suppose the "material of the universe to be composed of a series of vortex-rings developed from an invisible universe" and residing in a near perfect fluid.[75] The ether, they conclude, is not subject to degradation because God set its vortical atoms in motion. With the conservative and continuous nature of the ether's substance in place, Stewart and Tait now have their solution to the problem of material and spiritual degradation. The ether provides the mechanism by which energy is conserved, communicating memories of energy and information throughout the cosmos. Vortex-atoms, themselves free of the ordinary laws of dissipation, are near-perfect containers that together constitute a vast, cosmic archive for the storage of material information.

But the ether is also a "bridge between … the visible universe" and the unseen spiritual universe, a vast interstellar network allowing both for the transmigration of souls and the directive hand of God in the physical world.[76] "[W]hen energy is carried from matter into ether," Stewart and Tait write, "it is carried from the visible into the invisible; and … when it is carried from ether to matter it is carried from the invisible into the visible."[77] The apparently wasteful nature of the universe is an illusion. Every material and spiritual action is impressed upon and stored by the ether, the universe

[73] Ibid., 15.
[74] Harman, *Energy*, p. 84.
[75] Stewart and Tait, *Unseen*, p. 118.
[76] Ibid., p. 158.
[77] Ibid., p. 159.

keep[ing] up a memory of the past".[78] The sun might not be an eternal lamp but its radiant effusions and the terrestrial life its energy powers are never truly lost. Stewart's entropic narrative has thus come full circle. Dissipation reigns as a force in the material world. But with the power of the 'unseen universe' added to the equation, immortality is made possible through the ethereal conservation of the soul.

The story does not end here, however. Because, in spite of Stewart and Tait's continuity principle, the very concepts grounding their analogical inference of immaterial conservation became degraded. Although *The Unseen Universe* was immensely popular with the public, critics were not so enthusiastic. Scientific and Christian commentators attacked Stewart and Tait's analogical reasoning—in particular, their notion of epistemological and ontological continuity. In *The Theological Review*, Charles Beard claimed that the then unknown authors, "plainly men of genuine and deep religious feeling" had grounded their work in multiple "departments of thought".[79] Nevertheless, the ideas Stewart and Tait presented, "which in their own belief lay quietly side by side without consciousness of intellectual incongruity" in fact produced "the strongest mutual repulsion in the minds of others".[80] Stewart and Tait, in other words, had failed to appreciate that the analogical continuity they saw as indisputable, was merely an idealistic construct of their own imaginations.

In 1887, the book's detractors' were proved correct. An experiment by Albert Michelson and Edward Morley that set out to detect the relative motion caused by ethereal friction in fact found no such evidence. Instead, to their surprise, the experiment suggested that the ether did not exist. With this discovery, Stewart and Tait's central claim was made redundant. And not only that, their book had shown that the principle of continuity, as both an epistemological and ontological formulation, was irrecoverably flawed. The material world had outsmarted them. With hindsight, it is possible to see that Deleuze's critique of analogical thinking is relevant here in almost

[78] Ibid., p. 156.
[79] Charles Beard, 'Physical Speculations on Immortality: Review of *The Unseen Universe*', *The Theological Review*, 12.50 (1875), 406-23 (p. 407).
[80] Ibid., p. 407.

every aspect. The interiority between terms that constrains meaning; the linearity of argument that transforms ideas into speculative fictions; the projection of phenomenological stability onto the workings of 'external' matter; and the sublimation of instability and heterogeneity under the notion of continuity and semblance—all these problems with *The Unseen Universe* are a direct result of Stewart and Tait's analogies of conservation and continuity. Thus, paradoxically, in its attempts to counter the loss of moral and spiritual information, *The Unseen Universe* itself became a degraded text. A little over a decade after its publication, the book, in terms of being a theological argument justified by science, become largely useless. Its only real 'value' lies in what it tells modern readers about the construction and failure of thermodynamic analogies in the 1870s. Even after numerous revisions, *The Unseen Universe* quickly became a dissipated ruin.

2.4 Eternal energy in *Heat a Mode of Motion*

Before Stewart, Lockyer and Tait had penned their entropic eschatologies in the late 1860s and mid 1870s, Tyndall had already completed his thermodynamic masterpiece, *Heat Considered as a Mode of Motion* (1863). Like *The Unseen Universe*, the book was immensely popular with the general public; it was reprinted multiple times and translated into numerous foreign languages. "[N]o book", claimed an 1892 *Popular Science* article on Tyndall's work, "has done more to spread an understanding of the nature and behaviour of one of the great forces of Nature than *Heat as a Mode of Motion*".[81] The volume was formed from a revised collection of twelve lectures on heat delivered at the Royal Institution during 1862. Tyndall had been delivering popular lectures at the R. I. since 1853 and had earned a reputation as Victorian Britain's foremost scientific showman. Conjoining exposition with demonstrative flair, he aimed to explain new scientific principles to anyone possessing a basic "imaginative faculty

[81] Anon., 'Literary Notices: *New Fragments*, by John Tyndall', *Popular Science Monthly*, 41 (1892), 127-28 (p. 127).

and power of concentration."[82] But convinced that simple explanation on its own could not do justice to the strange world of matter and energy, Tyndall put on fantastic experimental displays, dazzling audiences with the "manipulation of an accomplished conjurer".[83] Flames would be made to 'sing'; colourful effusions would be created from the electrical attenuation of gases; cigars lit from focused beams of infrared radiation. Some of Tyndall's colleagues in the scientific community, particularly Tait and Maxwell, considered these displays to be overly showy and detrimental to the scientific education of the general public. Audiences, however, loved the R. I. lectures; for George Eliot, they were "as fashionable an amusement as the Opera."[84]

Grouped together in a single volume and without Tyndall the conjurer's visual spectacles, the *Heat* lectures lose some of their performative effect. To counteract this loss, Tyndall energises his prose, imagery and descriptions of thermodynamic processes. Of course, heat proliferates throughout the book—from the 'fiery embraces' of molecules to the massive cosmic furnaces of stars. But a literary sort of heat also pervades the book's textual matter: its language fizzes with a raw energy, sometimes building in imaginative power to cultivate a sense of profundity, at other times generating an excess of rhetorical waste.

In both cases, Tyndall re-emerges as the spellbinding showman, words functioning as his dancing flames. Like his descriptions of the Alpine landscape, thermodynamic spaces are reified into visions of sublime awe and terror. From mountainous "ridges and chasms" burst "enormous masses of steam", "hissing and roaring" with "the loudness of thunder".[85] Digging deeper below the earth's surface, "we have smoking mud pools, where a repulsive blue-black aluminous paste is boiled, rising at times in huge bubbles, which, on bursting, scatter their slimy spray to a height of

[82] John Tyndall, *Heat Considered as a Mode of Motion* (Cambridge: Cambridge University Press, 2014), p. iii.
[83] 'Prof. Tyndall, D.C.L., LL.D, F.R.S. [obituary]', *The Athenaeum*, 3450, (1893), 811.
[84] As quoted in Young, *Tyndall*, p. 15.
[85] Tyndall, *Heat*, p. 119; 120.

fifteen or twenty feet."[86] The period at the end of this sentence marks a point of thermodynamic inflection. Before it lies this realm of infernal pandemonium, red-hot geysers spewing black, sulphurous ooze; after it, a frozen palace of ice, uncompromisingly cold and desolate:

> From the bases of the hills upwards extend the glaciers, and above them are the snow-fields which crown the summits. From the arches and fissures of the glaciers, vast masses of water issue, falling at times in cascades over walls of ice.[87]

Scattered throughout *Heat* are these moments of sudden change between spaces of thermodynamic extremity. If one reads Tyndall's Alpine books alongside *Heat*, these thermo-spatial differentials become even more oppositional. Moving from the intense cold of icy wildernesses and empty space to the scorching heat of industrial and volcanic fires is more than a dramatic affection: it has a specific educational purpose. The extremes of thermodynamic sensation are used in service of thermodynamic *sensationalism*, as the theatrics of language replace the theatrics of the lecture hall. As the previous chapter argued, Tyndall intends the manoeuvre to encourage in his readers an expansion of the mind into the world of scientific imagination: "a world not less real than that of the senses, and of which the world of sense itself is the suggestion and justification".[88]

Maxwell pointedly satirises Tyndall's sensationalism in a poem composed for the Red Lion club in 1871 (later published anonymously in *Nature* that same year).[89] The first-person mock scientific hero of 'To The Chief Musician Upon Nabla. *A*

[86] Ibid., p. 120.
[87] Ibid.
[88] Tyndall, 'Scientific Use', p. 10.
[89] The Red Lion club was a group of predominantly Christian scientists who would meet privately during the annual meeting of the BAAS.

Tyndallic Ode',[90] emerges godlike from regions of intense cold and heat, battling with icy forces and molecules charged with fiery sexual energy:

> I come from fields of fractured ice,
> Whose wounds are cured by squeezing,
> Melting the cool, but in a trice,
> Get warm again by freezing.
> …
> I come from empyrean fires—
> From microscopic spaces,
> Where molecules with fierce desires,
> Shiver in hot embraces.[91]

This thermodynamic man, only a somewhat exaggerated caricature of Tyndall, is presented as a flamboyant virtuoso, seemingly able to make matter dance to his tune but only by using all the tawdry tricks of the spiritualist:

> I light this sympathetic flame,
> My faintest wish that answers,
> I sing, it sweetly sings the same,
> It dances with the dancers.
> I shout, I whistle, clap my hands,
> And stamp upon the platform,
> The flame responds to my commands,
> In this form and in that form.

Just as the opening two stanzas conjure spaces of extreme intensity, leaping from the freezing to the infernal, the vast to the microscopic, and full of "fierce desires", "wounds" and violent forces, so this verse is also characterised by oppositional frenzy. The tone, initially "sympathetic", "faint", and "sweet" is destroyed by the scientist's bombastic actions and "exaltations". In these verses, the boorish thermodynamic

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[90] "Nabla was the name of an Assyrian harp of the shape ▽. ▽ is a quaternion operator … whose use and properties were first fully discussed by Professor Tait, who is therefore called the 'Chief Musician upon Nabla.'" *JCM*, p. 634.

[91] James Clerk Maxwell, 'To The Chief Musician Upon Nabla: *A Tyndallic Ode*', in *JCM*, pp. 634-36.

showman wrestles with nature and commands it to obey him. But he does so with paradoxical intensity: he gets “warm again by freezing” and “shiver[s] in hot embraces”.

Maxwell evidently noticed in Tyndall’s lectures and written works a propensity for thermodynamic sensationalism and extreme, almost paradoxical tensions between oppositional forces. Combined with the Tyndallic showman’s demonstrative flamboyance, scientific “impressions” are hence “transformed by mental acts, / To permanent possessions.” These two traits of the scientific populariser—his showy mannerisms and oppositional encounters with hot and cold forces—shape the thermodynamic narrative presented in *Heat*. Maxwell was justified in criticising Tyndall’s sensationalism; it distorts thermodynamic law to promote instead a productivist utopia abounding with eternal energy. Indeed, *Heat* is more than simply a scientific treatise: it is also a quasi-scientific *treatment* of heat, both as material phenomenon and, for Tyndall, an ideological tool to be manipulated. Like Lockyer, Stewart and Tait, Tyndall never truly accepts the mechanical fact of entropy. By implying the universe had a beginning in time, entropy raises the possibility of a divine creative force: a force which he is keen to negate in order to advocate in its place a self-sustaining material universe. But whereas the Christian scientists subsumed entropy within a greater principle of spiritual conservation, Tyndall subsumes it within eternal material conservation. Entropy is expunged almost entirely from *Heat*. It is replaced instead by an immanent atomic vitalism, which, along with the countless stars in the cosmos, generates a constant source of practically infinite energy.

Heat’s thermodynamic universe, moreover, is one where time’s entropic arrow holds little sway. Material transformations through time do not tend toward disorder. Rather, they are imagined as recuperative processes, driven by cyclical, seasonal durations and taking place within a universal continuum without beginning or end. *Heat* thus represents a similar project to that undertaken by the authors of the ‘Sun’ essay and *The Unseen Universe*. Like those texts, Tyndall’s book posits an ontology in which matter and time take on transcendental, metaphysical qualities. Moreover, analogical reasoning is used to make imaginative leaps, from established proposition to untestable speculation: specifically, that the universe is governed by a unifying conservative force that prevents entropic decay. Tyndall links things together, objects, forces, processes, and so on, in great causal and analogical chains. The former consists of statements about cause and effect: *the sun makes plants grow, which are eaten by animals that transform this fuel into muscular movement*. The latter consists of statements about proportional similarities: "the power which raised the tree, and which wields the axe [are] one and the same".[92] Analogical linking in particular constitutes a form of equivocation which, I will argue, acts for Tyndall in the same manner as his take on the law of conservation. It creates an equilibrium between potentially oppositional concepts such as the organic and inorganic, progressive and cyclical time. Hence, at both the level of thematic content and the formal operations of the text, ontological continuity—the idea that things behave in a similar fashion across all spatiotemporal scales—and phenomenological assuredness—a sense in which conditions have been conducive to human life in the past and will continue to be so in the future—dictate the direction of Tyndall's sensationalist thermodynamic argument.

Solar energy, and the transformations it effects, takes on the role of the thermodynamic showman in *Heat*. In the absence of singing flames and coloured gases, Tyndall transfers to the sun his magician like powers as, across the pages of his book, the solar "Proteus works his spells".[93] In the 'Sun' essays, Stewart and Lockyer's sun was transfigured into an analogical type. Just as the sun maintains a delicate connection to its surrounding planetary life, they argued, so too does the universe consist of a delicate network stretching between the material and spiritual. The sun, in their essay, with both its creative and destructive energy, is a material analogue of an immaterial, supremely energetic God. In working its 'Protean' magic, Tyndall's sun performs a similar function, but is distinct from Stewart and Lockyer's in two ways.

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[92] Tyndall, *Heat*, p. 432.
[93] Ibid., p. 433.

Analogically, it is used by Tyndall to infer a universal, invariant and all-encompassing vital principle. One of *Heat*'s foremost claims is that "all terrestrial power is drawn from the sun": "every mechanical action on the earth's surface, every manifestation of power, organic and inorganic, vital and physical."[94] But rather than emphasise the inefficiency of these thermal transactions between the sun and earth—such as the immense quantities of heat ejected out into the cold and dead regions of empty space—Tyndall instead casts them as inherently recuperative. Machines are like inorganic plants, using carbon dioxide and converting it into breathable oxygen. As engines convert energy originating in the sun into work, "moving force is restored to its first form; the energy of the machine has been consumed in reproducing the power from which that energy was derived".[95] The manner in which Tyndall expresses the conservative circularity of these thermal operations (heat → work → heat) rides a fine rhetorical line between fact and fiction. A careful reader, educated in the technical specifics of thermodynamic theory might recognise that the waste heat *produced* by engines is different from the usable heat difference *powering* them. To the casual reader, however—such as the commentator quoted in this chapter's introduction who doubted the two laws on the grounds of their apparent incompatibility—Tyndall's words might well be read as arguing for perfect thermodynamic sustainability. Given, as Tyndall often claims, that the universe as a whole is pervaded by "the grand principle of the conservation of force", is it not possible that other closed systems are able to maintain an ideal equivalence between heat and work? In this way then, the sun is figured as an analogical type for a wider principle of energetic equilibrium. Yet this does not automatically remove God from Tyndall's universe. In fact, instead of being conceived as analogous to God as in Stewart and Lockyer's essay, the sun in *Heat* becomes a god in its own right.

[94] Ibid., pp. 431–32.
[95] Ibid., p. 119.

The sun-as-god motif finds its rhetorical apotheosis in a lengthy eulogy to solar energy in *Heat*'s concluding pages. In one of his extensive poetic itemisations, Tyndall exclaims of the sun:

> His warmth keeps the sea liquid, and the atmosphere a gas, and all the storms which agitate both are blown by the mechanical force of the sun. He lifts the rivers and the glaciers up the mountains; and thus the cataract and the avalanche shoot with an energy derived immediately from him. Thunder and lightning are also his transmuted strength. Every fire that burns and every flame that glows dispenses light and heat which originally belonged to the sun. … He rears, as I have said, the whole vegetable world, and through it the animal; the lilies of the field are his workmanship, the verdure of the meadows, and the cattle upon a thousand hills. He forms the muscle, he urges the blood, he builds the brain. His fleetness is in the lion's foot; he springs in the panther, he soars in the eagle, he slides in the snake.[96]

This invocatory song to the sun is Tyndall at his most effusive. The ellipses separating chunks of the above quotation (and indeed, Tyndall's throwaway remark, "as I have said") should hint at the sheer length of this passage; there is great deal of loquacious heat produced but little in the way of actual expository *work*. In its at once submissive prostration and sense of heightened self-importance, the language echoes traditional praise poetry. It has less in common with the quiet introspection of the Psalms, however, and more with pre-biblical motifs found in poems such as Akhenaten's 'Great Hymn to the Aten'. Yet, in the midst of Tyndall's outpouring of solar praise, he has the temerity to say to his readers, "remember, this is not poetry, but rigid mechanical truth."[97] In fact, it is an uneasy combination of the two and neither convinces: partly because Tyndall's attempt at poetic language reads as excessively devotional and partly because his 'mechanical truth' is a fantastical reinterpretation of thermodynamic principles. Indeed, one critic claimed of the passage that it "is neither science nor poetry" but rather a "specimen of [a] vicious style … no longer 'the Exact Sciences,' but

[96] Ibid., p. 432.
[97] Ibid., p. 432.

‘the Imagination as an aid to discovery’”.[98] Yet the most damning charge this particular detractor (and indeed many others) levelled at Tyndall was that he makes “the Sun usurp the prerogatives of God”.[99] Indeed, if Tyndall’s solar panegyric achieves a certain cosmic sublime, it nonetheless cultivates this sense of thermodynamic wonder from “the idea of the sun as a *final* agent, a sort of force-god, or ‘*god of forces*’ [emphasis original]”.[100]

This criticism has a ring of truth to it. Unarguably, Tyndall portrays the sun as cosmic engine powering life on earth *and* as a deity from which all energy is generated. Thunder and lightning, for example—forces of nature traditionally imagined as divine weaponry or the emotional vagaries of an angry God or gods—are recast as an extension of the sun’s strength. But the deification of the sun is most readily played out in Tyndall’s rhetoric. The attribution of the personal, masculine pronoun ‘he’ to the sun (which, because of Tyndall’s use of short, anaphoric sentences, often appears on the page capitalised as ‘He’) and the liturgical cadence of his syntax, build in oratorical intensity like an incantation: *He forms the muscle, he urges the blood, he builds the brain*, and so on. This passage’s worshipful ethos, and indeed, its stylistic mannerisms, crop up repeatedly in Tyndall’s texts. In *Hours of Exercise*, Tyndall describes looking “over [the] wondrous scene towards Mont Blanc” and pondering “ [h]ow was this colossal work performed?”[101] “[The] answer”, he replies, “was at hand”:

Ever young, ever mighty—with the vigour of a thousand worlds still within him—the real sculptor was even then climbing up the eastern sky. It was he who raised aloft the waters which cut out these ravines; it was he who planted the glaciers on the mountain-slopes, thus giving gravity a plough to open out the valleys; and it is he who, acting through the ages, will finally lay low these mighty monuments, rolling them gradually seaward—Sowing the seeds of continents to be.[102]

[98] Taylor Lewis, ‘Scientific Rhodomontade’, *The College Courant*, 14 (1874), 87-88 (p. 87).
[99] Ibid., p. 87.
[100] Ibid., p. 87.
[101] Tyndall, *Hours*, p. 190.
[102] Ibid., pp. 190-1.

The syntax and imagery of Tyndall's solar panegyrics recall similar expressions of praise in the Bible:

> For, lo, he that formeth the mountains, and createth the wind, and declareth unto man what *is* his thought, that maketh the morning darkness, and treadeth upon the high places of the earth, The Lord, The God of hosts, *is* his name [emphasis original].[103]

Thus, bestowed with the universal power to act "through the ages" (a capacity that is expressed in the abundance of verbs), the Tyndallic sun supplants the position formerly occupied by God in Christian ontology, and replaces the divine Logos with a purely materialist utterance.

As Gowan Dawson has argued, evangelicals perceived Tyndall's heliocentric inclinations as evidence of a tacit revival of paganism in Victorian Britain. Writing in the *Contemporary Review* in 1873, for example, St George Mivart accused him of being "a high priest" at the service of a "pagan sun-deity". Dawson elaborates:

> Tyndall's lengthy panegyric on the supreme importance of the sun in *Heat Considered as a Mode of Motion* (1863), in which he drew on Greek mythology in eulogizing the remarkable 'mechanical force' by which this 'Proteus works his spells', might even constitute a new heathen prayer book for what Mivart termed 'the naturalistic Pagan revival' of the nineteenth century.[104]

Aware of such accusations, Tyndall facetiously admits to the charge in a footnote added to the end of an Alpine mountaineering account from 1863: "Eight years ago I was evidently a sun-worshipper; nor have I lost the conviction of his ability to do all here ascribed to him.—J. T., 1871."[105] This remark aside, Tyndall's deification of the sun constitutes an attempt to entrope thermodynamics in the language of religious sensationalism. Indeed, the semantics of Tyndall's Alpine adventures combining romantic idealism with industrious visions of personal and mechanical power is evident

[103] Amos 4. 13. *The Bible: Authorized King James Version with Apocrypha*, eds. Robert Carroll and Stephen Prickett (Oxford: Oxford University Press, 1997).
[104] Dawson, *Darwin, Literature and Victorian Respectability* (Cambridge: Cambridge University Press, 2007), p. 87.
[105] Tyndall, *Hours*, p. 191.

in his solar narrative too. Modern science, Tyndall says, has shown us that the magnitude of the sun's energy "constitute[s] a poem more sublime than has ever yet been addressed to the intellect and imagination of man." Indeed, "so great and grand" are the conceptions of this poem that they "beggar those of Milton" and inspire in less hardy men overwhelming "bewilderment."[106]

But within Tyndall's paean to the solar sublime is also an idealisation of mechanical work itself. In Stewart and Lockyer's essay, this is rendered in their agrarian vision of windmills, watermills and ploughed fields; in Tyndall's narrative, the pastoral is demolished as the engines, drills and the weapons of war ravage the natural landscape. While Tyndall's praise of solar energy initially focuses its attention on the world of organic vitality, it thus rapidly mutates into a worship of industrialisation. More problematically, Tyndall obscures the role humans play in this process. The sun carves crevices in mountains and feeds organic growth but it also, according to Tyndall, brings about the destruction of the ecosystem:

> he urges the projectile, he bursts the bomb. … He builds the forest and hews it down … The clover sprouts and blossoms, and the scythe of the mower swings by the operation of the same force. The sun digs the ore from our mines, he rolls the iron; he rivets the plates, he boils the water; he draws the train. …There is not a hammer raised, a wheel turned, or a shuttle thrown, that is not raised, and turned, and thrown by the sun.[107]

Tyndall unerringly presents the exploitation of the environment as a positive process. In this productivist utopia, work "becomes a standard-bearer of moral meaning".[108] But, as Allen MacDuffie correctly notes, this moralisation of work callously "mixes the organic with the mechanical" so that industrial action is given the same ontological status as natural growth:

[106] Tyndall, *Heat*, p. 433.
[107] Ibid., p. 432.
[108] Anthony Giddens, *Beyond Left and Right: The Future of Radical Politics* (Cambridge: Polity Press, 1994), p. 175.

[T]he easy syntactic balance of a phrase like 'He builds the forest and hews it down' conceals the deeper mismatch between the chronologies of building and hewing. The first, the development of a forest, may take thousands of years; the second can be accomplished in weeks or months, but the sense of easy transformability levels such crucial ecological distinctions.[109]

Again, this is not an isolated occurrence in Tyndall's writings on energy. Frequently, slippery logic is used to portray the sun, not humans, as driving terrestrial manifestations of mechanical power. This is accomplished through Tyndall's analogical comparison between the forces of Nature and human labour. In a revised edition to *Heat* that includes a further lecture delivered in 1862, industrial machinery is used to demonstrate through "analogical processes … a clearer idea of the part played by the sun in vital actions."[110] Water, "descending by its own gravity" from a height may "be employed to turn wheels, wield hammers, grind corn, or drive piles."[111] Likewise, "the energy of man and animals" constitutes "the parcelling out and distribution of energy originally exerted by the sun."[112] Three years later in 'Vitality' (1865), the industrial complex again becomes a site where solar activity and value production on earth meet. "It [solar energy] may … be caused to set complex machinery in motion, to turn millstones, throw shuttles, work saws and hammers, and drive piles."[113]

Such an abundance of aggressive hewing, sawing, smashing, mining and scything shows that what really energises Tyndall is the convergence of solar energy with human *agency*. Although these passages attempt to obfuscate the boundaries between organic and mechanical forces by analogically correlating natural growth and intentional harvesting, elsewhere, Tyndall reveals that such productivist enterprise necessarily owes its existence to man's actions. Damon Anderson defines productivism as the belief "that economic growth and work … are permanent and necessary features

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109 Allen MacDuffie, *Victorian Literature, Energy, and the Ecological Imagination* (Cambridge: Cambridge University Press, 2014), p. 41.
110 Tyndall, *Heat Considered as a Mode of Motion* (Revised American edition) (New York: D. Appleton and Co. 1869), p. 511.
111 Tyndall, *Heat* (revised), p. 511.
112 Ibid., p. 512.
113 John Tyndall, *Fragments of Science*, 2 vols (New York: D. Appleton and Company, 1896), II, p. 48.

of human existence, regardless of their adverse impact and consequences, social, cultural and environmental".[114] The ideological anthropocentricism at the heart of this paradigm informs Tyndall's certainty that it is a mere logical condition of progress that solar output will eventually be harnessed and controlled. Combined with ever-advancing technology, the "divine power of the human intellect which annihilates mere magnitude in its dealings with law" gives man the ability and "privilege to rise above these standards, and to regard the sun himself as a speck in infinite extension".[115] Humans' "divine powers" hence transform solar energy from pure potential into "triumphs of man's skill". Indeed, those "who have walked through the workshops of Woolwich, or through any of our great factories where machinery is extensively employed, will have been sufficiently impressed with the aid which this great power renders to man"[116].

From this praise of productivism emerges Tyndall's distortion of thermodynamic law. As MacDuffie demonstrates, the grouping together of entirely different temporal scales—the eons taken to build a forest, the years, even months taken to hew it down—falsely implies that an invariant, non-temporal law of conservation underlines all energetic transformations. Without this ontological predicate, Tyndall's productivist utopia is an impossible fantasy. Indeed, the industrial empire he imagines, in eternal equilibrium with the natural environment, is only possible by deriving its energy from the unerring invariance of Nature, which provides "a constant sum of power" to these incessant "Protean fluctuations" of productive enterprise.[117] Thus, tapping into nature's store of eternal power, humans can create ever more efficient machines capable of recycling energy and supplanting the power offered by nature alone. "The achievements of Heat through the steam-engine", Tyndall writes, provides a means by "which we can supersede the force of winds and rivers—of horses

[114] Damon Anderson, 'Introduction: Risk and Uncertainty' in *Work, Learning and Sustainable Development: Opportunities and Challenges*, eds. John Fien, Rupert Maclean and Man-Gon Park (New York: Springer, 2008), pp. 34-57 (p. 36)
[115] Tyndall, *Heat*, p. 44; 434.
[116] Ibid., p. 118.
[117] Tyndall, 'Science and Man', p. 597.

and of men". And with time, science—"a source of individual and national might"—will inevitably strengthen man's ability to exert energetic control over his environment: it is a development "as necessary and as irresistible as the motion of the tides, or the flowing of the Gulf stream. It is a phase of the energy of Nature".[118]

Throughout this vision of industrial might also runs a counter narrative to the theological hypothesis of a created material universe destined to apocalypse. Entropy has no place in Tyndall's utopia, despite the accelerated degeneration of energy being in reality a contingent by-product of increased industrial activity. In his paean to the sun, Tyndall builds an image of the universe as a closed system with a fixed and invariant store of energy—full of transformative flux but nonetheless foundationally stable and isolated from interference by an outside supernatural agency. The "great and grand" principle driving Tyndall's paean to the sun is thus the energetic balancing act conducted by the first law. Whereas Stewart and Lockyer at least acknowledged that the apparent contradiction between the first law's promise of conservation and the second's guarantee of degeneration is unified in heat death, Tyndall's thermodynamic narrative is altogether more fantastic. In fact, heat death is almost entirely expunged from Tyndall's book; the term 'dissipation' and its variants appear only five times, while 'degradation' is absent altogether (of course, Clausius would not coin the term 'entropy' for another two years). Instead, Tyndall takes the "grand principle" of the first law, which he refers anachronistically to as "the conservation of force", to be the vital principle underlying energetic relations in the cosmos.[119] "To Nature nothing can be added; ... nothing can be taken away; the sum of her energies is constant".[120] This interpretation is technically true. But without the corollary provided by the second law, Tyndall misleadingly perpetuates the notion of a universe where time is cyclical, not linear, and filled with a store of limitless, useable energy.

[118] Tyndall, *Heat*, p. xxi.
[119] Ibid., p. 118.
[120] Ibid., p. 434.

This is an intentional move that fits in with wider efforts undertaken by naturalist scientists to counter both theological narratives of dissipation and the low age estimate placed on the solar system by William Thomson. In the revised edition of *Principles of Geology,* Charles Lyell claims that "[i]t is a favourite dogma of some physicists, that ... the sun itself is continually losing a portion of its heat" and will soon bring about extinction.[121] Huxley also intervenes in this debate in a paper presented to the Geological Society of Glasgow in 1869. Not fully understanding the science, he cites the law of conservation as negating the dying sun hypothesis while at the same time pouncing on Thomson's admission of mathematical uncertainties in thermodynamic equations. "[T]he fact that so eminent a physical philosopher", writes Huxley, "confesses his own estimates to be 'very vague,' justly entitles us to disregard those estimates".[122]

Tyndall is invested in this debate for the same reasons as Huxley: to defend the credibility of evolution and negate the necessity of a creative act. The subheading of this particular lecture in *Heat* is titled 'Constancy of Power of Natural Forces'. Its phrasing emphasises continuity while the term 'force' is used to distinguish Tyndall's own brand of thermodynamics from the Christian physicists'. Moreover, as the previous chapter argued, Tyndall will later ally the mythological aspects of the Norse tree Igdrasil with modern scientific research in his lecture on 'Science and Man' to further counter William Thomson's uniformitarianism. In both *Heat* and this later work, time is conceived as deep and cyclical, full of continual Carlylean transformations rather than linear degradation. Energy, in other words, is invariant: "the flux of power is eternally the same."[123] Tyndall thus also adopts an ontological paradigm founded on stability and *continuity*. Humanity, meanwhile, is granted a form of immortality—not through the storage of information in an immaterial archive—but by its capacity to harness and use

[121] Charles Lyell, *Principles of Geology, Or the Modern Changes of the Earth and its Inhabitants*, 3 vols, (London: John Murray, 1868), II, p. 213.
[122] T. H. Huxley, *Collected Essays Volume 8: Discourses: Biological and Geological*, 9 vols (Cambridge: Cambridge University Press, 2011), VIII, p. 336.
[123] Tyndall, *Heat*, p. 434.

a limitless supply of material energy. The grinding mills, the piles driven into the ground—these will secure humanity's future and protect it from entropy. And, in presenting the sun as a near infinite source of constant light and heat, Tyndall counters theological eschatology with materialist eternity. In over-emphasising the first law's promise of conservation, he overrides the second law's promise of increasing disorder. Neither created nor destroyable, the cosmos is ever-lasting, the "law of conservation rigidly exclude[ing] both [its] creation and annihilation."[124]

Tyndall's transformation of scientific fact into speculative pseudoscience did not go unnoticed by his critics. "The scientific teaching which I believe implies false ideas about nature" writes St. George Mivart in 1878, "is that which concerns the 'conservation of energy,' or, as it was earlier named, the 'persistence and transformation of force.'"[125] Tyndall never *quite* says that energy and time are totally unlimited resources, but his terminology is rhetorically evasive. "Multiplying all our powers by millions of millions, we do not reach the sun's expenditure", he writes. "Measured by our largest terrestrial standards, such a reservoir of power is infinite".[126] Of course, a practically infinite source of power itself requires an equally miraculous fuel to sustain it. Yet, as Bruce Clarke notes, accounting for "the sun's steady rather than diminishing production of light and heat" in "the solar physics of Tyndall's time, decades prior to the understanding of nuclear energy" gave rise to a number of contradictory theories.[127] One of the hypotheses that Tyndall puts forward is the 'meteoric theory', expounded not only in *Heat* but also in essays and popular lectures delivered at the Royal Institution throughout the 1850s-1880s. In this theory, the "sun is nourished, and his supply of light and heat kept up, … by the showering down of meteoric matter upon the [its] surface".[128] The vast quantities of debris flying through empty regions of the solar system, supposedly just the waste product of planetary

[124] Ibid., p. 434.
[125] St. George Mivart, 'Force, Energy and Will', *Nineteenth Century*, 3 (1878), 933-48 (p. 934).
[126] Tyndall, *Heat*, p. 433.
[127] Clarke, *Energy Forms*, p. 130.
[128] Tyndall, *Heat*, pp. 43-44.

formation, in fact provide the sun with a constant source of power. They constitute entire "worlds of solid coal" shovelled into the solar engine.[129]

Once again, machines and engines are used as analogues for natural processes. Tyndall, like Stewart and Lockyer, also sees a "perfect analogy" between living beings and machines, specifically in relation to the "oxidation of the food in the body, and that of the coal in the furnace."[130] But for Tyndall, the analogy serves to affirm the purely material basis of life. Seemingly unaware that he is calling to mind the thermodynamic fantasy of the eternal lamp, Tyndall follows Mayer in conceiving of blood as "'the oil of the lamp of life'". Indeed, he continues, "all animal motions [may be deduced] from the combustion of this oil, as the motions of a steam-engine are deduced from the combustion of its coals."[131] The means, however, by which this 'oil' itself receives its primordial energy, is a question that leads Tyndall to create even more imaginative analogies. He also believes in an unseen source of directive, organising power. But whereas the theistic scientists ultimately believed this source emanated from an immaterial realm, Tyndall finds it buried deep inside the fundamental building blocks of matter. Of course, like the treatment of ethereal space in *The Unseen Universe*, the atomic domain evades direct perception: its existence and properties can be inferred only by indirect means. As such, it makes the atomic realm a liminal paraspace ripe for the speculative construction of fringe science.

The sun, Tyndall claims, is a near perfect engine powered by molecular fuel. Indeed, "molecular forces, though operating in such minute spaces, are almost infinite in energy."[132] Before diving into Tyndall's molecular analogy, it is worth considering his (mis)use of 'force' as an interchangeable synonym with 'energy'. Partly a rhetorical strategy aimed at wrestling sole ownership of thermodynamics from the North British and theistic scientists, the solecism also belies Tyndall's take on what constitutes 'forceful relations'. For one, his near universal decision to use 'force' in place of 'energy'

[129] Tyndall, *Fragments*, I, p. 11.
[130] Tyndall, *Address*, p. 22.
[131] Ibid.
[132] Tyndall, *Heat*, p. 84.

is bound up with his combative character and praise of man's muscular and intellectual powers. As we have seen, this belief culminates in a vision of widespread industrial control. Tyndall genders this brand of force as masculine; it conquers mountains, drives piles into the ground, harnesses energy. And yet, existing in tension with this idea, Tyndallic force is also conceived as an almost numinous vital power. Indeed, it is derived from Carlyle's reformulation of the "molecular force inherent within the Newtonian framework"—a source of mysterious power that is not deterministic but characterised by "a truly vital and *infinite* character."[133] The problem is that Newton never defined what actually force was: under his formulation, it remained an abstract concept. What Newton did claim, however, was that "force consists in the action [upon a body] only; and remains no longer in the body, when the action is over".[134] In other words, force is given the same ontological status as time and space. It does not "result from the specifick Forms of Things" but rather is a "general [Law] of Nature, by which the Things themselves are form'd".[135] Tyndall takes this notion of force as a general law from which material forms arise. But, by adopting Carlyle's spin on Newton, he also has it both ways. Force remains an abstract all-encompassing principle, but, for Tyndall, it also becomes immanent to matter: "[i]t is the compounding, in the organic world, of forces belonging equally to the inorganic, that constitutes the mystery and the miracle of vitality".[136] Whereas energy and entropy are the powers governing the Christian scientists' cosmos, in Tyndall's it is force: both as a mechanical thing and an abstract vital action.

In the supplemental lecture added to the revised edition of *Heat*, Tyndall's notion of molecular force is still rather vague, although it hints at its later imaginative development. Water flow (energy) provides motion; but the "*form* of the motion depends on the … machinery interposed" in its path (work). Analogically, Tyndall infers that a similar process takes place at the submicroscopic scale. Radiant heat from the

[133] DeYoung, and Carlyle as quoted in *Vision*, p. 66.
[134] Newton, *Principles*, p. 74.
[135] Newton, *Opticks* (New York: Dover Publications, 1952), p. 401.
[136] Tyndall, *Fragments*, II, p. 50.

sun is distributed and "conditioned by atomic machinery", which "determine[s] the *form* the solar energy will assume": "a cabbage … an oak … a grasshopper."[137] Somewhat confusingly, both 'atomic' and 'molecular' are terms used interchangeably while distinctions between the role of force and machinery are blurred. Molecular groupings are not themselves power sources but instead agencies directed by (in this system) 'external solar energy'. The analogy here gives an impression of the directive function of molecular forces but many finer points remain unclear. How, for example, does matter organise itself? What molecular principle gives it a near infinite source of eternal fuel?

In an 1868 lecture delivered to the BAAS at Norwich, Tyndall addressed this "ultimate problem of physical science"—what internal mechanism gives matter its vital spark?[138] "Guided by analogy," Tyndall explains molecular phenomena in terms of ancient building construction. Thinking of the Egyptian pyramids, we imagine

> the swarming workers toiling at those vast erections, lifting the inert stones, and, guided by the volition, the skill, and possibly at time by the whip of the architect, placing them in their proper positions. The blocks, in this case, were moved and posited by a power external to themselves, and the final form of the pyramid expressed the thought of its human builder.[139]

Similarly, swarming among the constituent particles of matter, "there is an invisible population, controlled and coerced by some invisible master, placing the atomic blocks in their positions."[140] Aware the analogy has the flavour of an argument for design, Tyndall renders it in more scientific terms. In ancient Egypt, masters whipped slaves into action, forcing them to move the stones of the pyramids into place. But the atomic blocks of matter are "fixed in their places by the inherent forces with which they act upon each other." This analogy provides a more viable explanation of how immanent forces generate form and structure. Matter is directed by a "definite action of force"

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137 Tyndall, *Heat* (revised), p. 512.
138 Tyndall, *Fragments*, II, p. 78.
139 Ibid., pp. 79-80.
140 Ibid., p. 80.

which, counter to its supposed entropic nature, has a "tendency … to organise itself", independent of supernatural agency. Matter has no external slave master. Instead, its internal atomic architect forces it into organised forms. Hence as Daniel Brown notes, "Tyndall's atomic forces … provide a naturalistic mechanism that effectively inverts the natural theological argument, so that evidence of pattern and design is accordingly seen to demonstrate … nature's radical independence".[141]

The atomic architect arranging tiny blocks of matter into place soon became one of Tyndall's favourite analogies. In late 1868 he encountered Lucretius' *De Rerum Natura*, whose recent translation by H. A. J. Munro introduced him to an ontology predicated on atomic collisions. The *clinamen*, the name Lucretius gave to the unpredictable swerve of atoms, appealed to Tyndall's sense of matter's immanent vitality. For Lucretius, the clinamen guaranteed free will. For Tyndall, the clinamen allowed him to develop his notion of an unstable atomic arena whose particulate encounters were guided by the whip of a forceful, nonhuman principle.[142]

Throughout the late 1860s and 1870s, Tyndall used the atomic architect to present both an ontology free of divine agency and a materialism distinct from pure determinism. In 'Crystalline and Molecular Forces' (1875), the architect analogy is used to make the atomic realm a tangible space. Moreover, its counter-entropic tendencies imbued matter with "the conditions for its [own] production".[143] As "atom is … added to atom, and molecule to molecule" "the work of the atomic architect" becomes visible in nature. Though unseen, his forceful directions are "more rigid than those which guide a human builder when he places his bricks and stones together."[144] For Tyndall, deviant atomic motions thus explained how matter could, if not create itself ex nihilo, generate structural organisation. Consequently, the macroscopic tendency towards entropy could be offset by the atomic realm's tendency towards negentropy. But the analogical

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[141] Brown, *Poetry*, p. 151.
[142] Tyndall further details the value Lucretius's work had in expanding his practice of imaginative science in the Belfast Address.
[143] John Tyndall, 'Crystalline and Molecular Forces', *Popular Science Monthly*, 6 (1875), 257-66 (p. 266).
[144] Ibid., p. 263.

conceit also allowed Tyndall to take a seemingly prosaic and invisible process such as the crystallisation of salt, and turn it into a spectacular imaginative demonstration of nature's architect at work.

Of course, the almost unlimited power Tyndall grants his architect did not go unnoticed by his critics. Like Stewart and Tait's ethereal memory, it seemed to many unscientific, even absurd. In 1874, a short satirical poem titled 'Atom, the Architect' was printed in *Punch* magazine, which mocked Tyndall's transfer of agency from mind to matter:

> THESE 'Architectural Atoms!' O 'tis fine
> To see humanity so sadly dwindle!
> Let MICHAEL ANGELO and WREN resign;
> Atoms can build Cathedrals—so says TYNDALL.[145]

The following quatrains continue in this tone, the final verse hoping that the second law would "crush the sceptic silliness of TYNDALL." Around this time, Maxwell also wrote a number of poems satirising Tyndall's anthropomorphised atomic forces and the idea that blind material processes could construct an object as complex and mysterious as the human mind. In one such poem, the narrator ironically parrots Tyndall's Belfast Address: "There is nothing but atoms and void, all else is mere whims out of date!"[146] Naturally, the implication here is the opposite: that Tyndall's architect is no more than an analogy born from fashionable materialist and Carlylean philosophies. The anonymous poet in *Punch* implied that Tyndall had removed agency from humans: the "shrewd contractor" "Amid the violet ether" replacing the purposeful craftsmanship of Michelangelo and Wren. But the mock awe of Maxwell's narrator presents Tyndall's molecular organisation as a philosophical idealisation imposed onto matter rather than an illustration of empirical truth. Tyndall endows his atoms "with love and hate" and

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[145] Anon., 'Atom, the Architect', *Punch*, 67 (1874), 196.
[146] Maxwell, 'British Association, 1874. Notes of the President's Address', *JCM*, pp. 639-41 (p. 639).

"clothes them with force as a garment". Hence, in Carlylean fashion, molecular force is no more than nature 're-tailored'.

Although Tyndall's architect appears a few years after the publication of *Heat*, the idea is nonetheless latent in this earlier work. Indeed, Tyndall repeatedly attributes an immanent vitalism to his molecules and atoms, which "clash with a dynamic energy".[147] But the conclusion to *Heat* also shows Tyndall's passion for the spectacular and the sublime. As with Stewart and Lockyer and later Tait, Tyndall's solar hymn finds in the cosmos greater sources of energy than the sun. But whereas for the theistic scientists this is a 'Supreme Intelligence', for Tyndall it is merely the massive cumulative power of the countless stars littered throughout space. The magnitude of our individual sun is subordinated, not to God, but to solar collectivism as a whole. Our star, powerful beyond measure, is still no more than "a mere drop in the universal sea" of energy.[148] If we could cross the universe, Tyndall explains, we would pass countless

> other suns, each pouring forth energy like our own, but still without infringement of the law, which reveals immutability in the midst of change, which recognises incessant transference and conversion, but neither final gain nor loss.[149]

The collective power of molecular force is thus expanded to the cosmic scale as the sun becomes just another atomistic singularity in a greater combination of unlimited 'stellar particles'. If the sun has near unlimited power in its own right, then the cumulative weight of an infinity of other suns suggests that, against the promise of heat death, the "energy of Nature is a constant quantity".[150] Thus, the sun, figured itself as a molecular unit—a block of matter moved by "the same primeval force" that exists "everywhere, under its infinite variety of appearances"—stands as a marker of eternal vitalism, of an apparently negentropic tendency in nature to eternal morphogenesis. To be sure, Tyndall's work in *Heat* often provides detailed and brilliant analysis of

[147] Tyndall, *Heat*, p. 148.
[148] Ibid., p. 433.
[149] Ibid., pp. 433-34.
[150] Ibid., p. 434.

thermodynamic principles. Even taking into account its problematic ecological ideology and sensationalised treatment of thermodynamics, it is still far less prone to exotic speculation than Stewart and Tait's theological musings. Nonetheless, Tyndall consistently overplays the "grand principle of the conservation of force" and avoids discussion of heat death.[151] Moreover, as the last chapter discussed in relation to his appropriation of the Igdrasil myth, the temporality of Tyndall's cosmos is defined by successive transformation and eternal rejuvenation. Indeed, Tyndall's transference of the primeval molecular force to the celestial stage serves to compound this universe suffused with immanent material power and afloat "in the infinite ocean of time".[152] Like a solitary particle of matter, the sun, in isolation, has a limited store of power. But collectively, suns last forever, producing unending energetic transformations quantified under "the never-varying total":

> Waves may change to ripples, and ripples to waves,—magnitude may be substituted for number, and number for magnitude,—asteroids may aggregate to suns, suns may resolve themselves into florae and faunae, and florae and faunae melt in air,—the flux of power is eternally the same. It rolls in music through the ages, and all terrestrial energy,—the manifestations of life, as well as the display of phenomena, are but the modulations of its rhythm.[153]

This closing passage is acutely Tyndallic: the expanding inventory of physical process; the equivalence of abstract, vital forces; the closing line, similar in poetic tone to the Wordsworthian "infinite azure" that will later conclude the Belfast Address. But critics were not blind to the purpose of such rhetoric. "He tries to exaggerate the imaginative effect of these laws by multiplying the trains of necessary consequences which radiate from, and the trains of necessary antecedents which converge in, each physical fact", wrote one such detractor.[154] Another, employing similar language, opined:

[151] Ibid., p. 118.
[152] Ibid., p. 430.
[153] Ibid., p. 434.
[154] Anon., 'Professor Tyndall on Science and Prayer', *The Spectator*, 38 (1865), 1196-97 (p. 1196).

Without this cumulative train, it would be felt that the truth so grandiloquently set forth has nothing very profound about it, or so far removed from the thinking even of those who do not claim to have a large amount of 'exact science.[155]

These criticisms are both valid. But perhaps it is fitting that the clearest exposition of Tyndall's thermodynamic sensationalism is rendered poetically by Maxwell:

—These transient facts,
These fugitive impressions,
Must be transformed by mental acts,
To permanent possessions.
Then summon up your grasp of mind,
Your fancy scientific,
Till sights and sounds with thought combined,
Become of truth prolific.[156]

With its utopian vision of eternal energy, its elision of human destruction and material entropy, and its praise of solar power, Tyndall's *Heat* thus conjures a pseudoscientific fiction. His limitless suns, powering the eternal cosmos, should be seen for what they are: the eternal lamps of thermodynamic fantasy and historical myth.

2.5 Conclusion: thermodynamic fantasies

As with *The Unseen Universe*, Tyndall's *Heat* also envisages a utopia where conservation abrogates entropy. Although conceived from almost antithetical philosophical standpoints, both use analogies to 'entrope' scientific ideas within imaginative textual spaces. Moreover, both texts show how scientific theories became entangled with literary and rhetorical figures and questions about the place of human life in a wasteful cosmos. In both these materialistic and theistic narratives, analogy is used to transform *unseen* realms into viable, visualisable spaces—from the

[155] Lewis, 'Scientific Rhodomontade', p. 87.
[156] Campbell, *JCM*, pp. 635-36.

submicroscopic clash of Tyndall's atoms, to the vast, ultra-material dimensional storage medium of Stewart and Tait's conservative cosmos. Although envisaging totally different universes—one which is directed by immaterial energy, the other wholly material—Stewart, Lockyer, Tait and Tyndall were thus united in their efforts to negate entropy.

For the Christian physicists, entropy was both a blessing and curse. While it implied that the cosmos had a beginning in time and was created by God, it also guaranteed the destruction of human life. Moreover, the wasteful tendencies of Nature seemed to undermine the notion that God had created a stable, ordered and balanced cosmos. Hence, Stewart and Tait took evasive action, circumventing these entropic implications by claiming the ether stored and transmitted the soul from the physical to the spiritual world. As this chapter has argued, Tyndall was similarly invested in negating the impact of entropy. If subatomic forces could produce self-organising structures, so too, he reasoned, could a universe composed of countless 'solar molecules' power itself through eternity. Such a closed, self-regulating system could exist free from any supernatural intervention. And by using their intellectual "powers", humans could control this abundance of energy and thus their own thermodynamic destiny.

In all these texts, analogy is used inventively. But it is also used to twist thermodynamic laws into idealised fictions. This is one of the critiques Deleuze levels at analogy: it obscures meaning and promotes false ideas about the world. Maxwell, however, bucks this trend. In contrast to these narratives, Maxwell engages in a different brand of analogical thinking. Crucially, his analogies are not intended to reinforce a pre-established idea. Instead, the meaning they produce is less static, more deconstructive. Indeed, Maxwell's unique poetic methodology shows that literary figures are more than simply entangled with scientific thought. As the following chapter argues, they also constitute a form of science-in-the-making.

CHAPTER THREE

Entropy, information and analogies part II: poetic negentropy and the chaotic instability of scientific law

What combinations of ideas,
Nonsense alone can wisely form!
What sage has half the power that she has,
To take the towers of Truth by storm?

Yield, then, ye rules of rigid reason!
Dissolve, thou too, too solid sense!
Melt into nonsense for a season,
Then in some nobler form condense.
—James Clerk Maxwell, 'Molecular Evolution'[1]

Introduction: Maxwell's methods

In a paper that would profoundly influence Maxwell's career, Michael Faraday described the potential of imaginative thinking in science. He wrote that the value of inexact speculations are twofold: they are "useful in *rendering the vague idea more clear*" but also "lead on, by deduction and correction, to the discovery of new phenomena, and … real physical truth."[2] As a methodological maxim, Faraday's words drove Maxwell's work. He believed that conceptual models could combine poetry, materiality and mathematics to generate new information in excess of their terms. As

[1] James Clerk Maxwell, 'Molecular Evolution' (1874), *JCM,* pp. 637-38.
[2] Michael Faraday, *Experimental Researches in Electricity*, 3 vols (London: Richard Taylor and William Francis, 1855), III, p. 408.

he wrote in 1858: "the appointed road to all scientific truth, whether metaphysical, mental, or social ... derives a great part of its value from ideas suggested by analogies".[3] Thus far, my discussion of thermodynamic entroping has implicitly agreed with Deleuze's critique that analogies produce false concepts. This chapter, however, shows that Deleuze's antipathy to analogy is misplaced. Maxwell's analogies, and their intersection with thermodynamic concepts, are radically different from Stewart, Tait and Tyndall's. Whereas those authors' attempts to subvert entropy resulted in the creation of thermodynamic fantasies, Maxwell instead uses a fictional construct to show how the second law's *innately probabilistic nature* contributes to its own theoretical deconstruction. Maxwell's analogies are not restricted by preordained ideological imperatives and predicated on phenomenological grounds: they have the capacity to, in Faraday's words, produce 'real physical truths' by functioning as partially autonomous *open systems*. While philosophy of science scholars have analysed the formal structures of Maxwell's analogies, the first departure this chapter makes is to consider how the non-sensical and semi-autonomous aspects of Maxwellian thought prefigure twentieth-century notions of negentropy by generating information in excess of their initial parameters. Hence, whereas the previous chapter was primarily concerned with the conservation and dissipation of energy, this chapter deals with the conservation and dissipation of *information*.

The second contribution I make is to consider how Maxwell's analogies combine science with poetry and mythology—particularly John Milton's *Paradise Lost*. Almost no critical attention has been paid to Maxwell's immense intimacy with Milton's epic: even less to how the poem profoundly influenced Maxwell's scientific and philosophical development of chaos, entropy and free will. Critics who have commented on Maxwell's frequent references to *Paradise Lost* see these instances as little more than attempts to "spice" the science.[4] On the contrary, *Paradise Lost* provided Maxwell with an

[3] Maxwell, *JCM*, p. 305.
[4] P. M. Harman, introduction to *The Letters and Scientific Papers of James Clerk Maxwell*, ed. P. M. Harman, 3 vols (Cambridge: Cambridge University Press, 2002), II, p. 7.

imaginative cosmos teeming with ideas that could be mapped analogically to contemporary problems. As his friend and biographer Lewis Campbell wrote, throughout Maxwell's papers are "the traces of … impressions derived through the poetry of Milton".[5] For instance, in an 1878 lecture, Maxwell draws an analogy between the distribution of electromagnetic lines of force in a field and "Milton's spirits which cannot 'in their liquid texture mortal wound / Receive, no more than can the fluid air'".[6] Maxwell often relies on poetic resonances such as these to explicate a scientific concept. But more than this, poetry was also productive for Maxwell in its ability to work in the margins between texts by producing conceptual slippages and disanalogies.

Beginning by outlining recent analyses of Maxwellian analogies, the chapter sketches Maxwell's early fascination with modelling. Following this is an examination of one of Maxwell's poems written while he was an undergraduate in the 1850s. Tracing the interplay between puns, analogies and Miltonic allegory it argues that the poem's inherent formal indeterminacy undermines the concept of absolute scientific law. Moreover, in its convergences between literary forms, the poem is concerned with the transformation, conservation and degeneration of ideas, and as such, constitutes a modelling of literary entropy. The chapter proceeds to explore how Maxwell appropriates Miltonic ideas to deconstruct the principle of continuity—in Tait and Stewart's *Unseen Universe* and in the work of reductive materialists. The final two sections discuss the connection of information with entropy in the writings of Christian apologist William Francis Barry, biologist Francis Galton and Maxwell. Following critics such as N. Katherine Hayles, I propose that Maxwell anticipated the theory of 'information entropy'. But he did so by incorporating Miltonic theodicy into his analogies and saw the potential for 'noise' to liberate free will in an entropic universe.

[5] Campbell, *JCM*, p. 227.
[6] Maxwell, 'Rede Lecture on "The Telephone"', Harman, *Sci Papers*, III, 651-64 (p. 657).

3.1 Analogies, models and black boxes

Maxwell's *Treatise on Electricity and Magnetism* pioneered a novel form of analogy. Published in 1873, the *Treatise* provided a comprehensive overview of the known science of electromagnetism. But the *Treatise* also contained Maxwell's "own unique approach" to the field of electromagnetic science: an approach "based on a quite different physical theory" to the dominant action at a distance model.[7] Ronald Anderson suggests that part of the book's work was to synthesise these two differing theoretical models in order to validate Maxwell's atypical ideas. To do this, Maxwell drew equivalencies between Continental electromagnetism and the British experimental tradition more broadly concerned with action at a distance, via a medium. He cross-translated between symbolic notation and physical observation in an attempt to ground electromagnetic phenomena equally in both domains. Moreover, he argued that the internal processes of different physical phenomena were comparable. The *Treatise*, Anderson thus claims, demonstrates Maxwell's ability to translate analogically the abstract, concrete, symbolic and physical.

Building on Anderson's work, Giora Hon and Bernard Goldstein delve into the intricacies of Maxwell's analogies.[8] They argue that the analogy in 'On Faraday's Lines of Force' is comparable to the "methodology of modeling as it is practised today."[9] Maxwell's analogy in this paper was innovative in its comparison of physical phenomena to a "carefully constructed fiction."[10] He did not look for an analogue of electromagnetism in physical reality but instead created an imaginary construct comprised of imaginary tubes filled with an incompressible fluid, which functioned as a simple working model. Maxwell's reworking of Faraday's electromagnetism was thus

[7] Ronald Anderson, 'Exploring the mathematical and interpretative strategies of Maxwell's *Treatise on Electricity and Magnetism*', *Endeavour*, 25 (2001), 157-65 (p. 157).
[8] See Jordi Cat, 'On Understanding: Maxwell on the Methods of Illustration and Scientific Metaphor', *Studies in History and Philosophy of Modern Physics*, 32 (2001), 295-441.
[9] Giora Hon and Bernard R. Goldstein, 'Maxwell's contrived analogy: An early version of the methodology of modeling', *Studies in History and Philosophy of Modern Physics*, 43 (2012), 236-57 (p. 239).
[10] Hon and Goldstein, 'Contrived Analogy', p. 253.

more truly 'mathematical' than 'physical'. It was also entirely novel. Indeed, in its introduction of "an artificial scheme whose properties are entirely at one's disposal" Maxwell's 'contrived' analogy anticipated modern science's "methodology of modeling."[11]

However, Maxwell's analogical method also prefigured notions of non-linear systems. In *Chaos: Making a New Science* (1987), James Gleick describes how in the 1960s, meteorologist Edward Lorenz realised that turbulent systems such as the weather never reach a point of fixed equilibrium. Instead, tiny changes made to input parameters could yield vastly different, non-linear outputs that would continue to bifurcate. This principle was colloquially known as 'the butterfly effect' and from it emerged a greater understanding of stochastic chaotic processes. But it also showed the potential for models to produce new scientific information, sometimes in excess of their creator's original intentions.

A hundred years prior to this, however, Maxwell was already beginning to see that models functioning with partial autonomy could generate unexpected information. Maxwell's scientific models maintained a curious relationship to material reality. They were not idealised structures, superimposed onto the external world, but constructs that were partially material themselves. Although they began as imaginary systems, Maxwell would take mechanical principles from them and apply them to real life phenomena. In turn, new discoveries about physical process would be imported back into a new, updated model, often showing him unseen similarities between imaginary and actual systems. But for Maxwell, generating new information was only one aspect of his science. Chipping away at the very logic underlying dominant epistemological formulations, taking 'the Towers of Truth by storm', was essential to his engagement with the world. The understanding that Maxwell arrived at was that laws really could be broken: even laws considered as immutable as thermodynamics. But this 'deviancy'

[11] Ibid., p. 240.

began long before his professional career. Even as a young child, Maxwell was already peering beyond the realms of sensible intuition.

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"What's the go o' that? What does it do?" These were words heard regularly by those who knew Maxwell when he was a young boy in Glenair, Scotland. By all accounts, he was an unusually intelligent and interested child. According to Lewis Campbell, the depth of his curiosity coupled with his wonderful memory gifted Maxwell with an "extraordinarily extensive and minute" knowledge of obscure and seemingly unrelated things (Maxwell and Campbell met when they were boys at the Edinburgh Academy in the early 1840s and remained lifelong friends until Maxwell's death in 1879).[12] But Maxwell was not content to accept received knowledge without questioning its fundamental tenets. Colours, for example, fascinated him; but before he could even properly express it, he was particularly concerned with whether their properties were perceived in the same way by others: "How d'ye know it's blue?" he would enquire.[13]

Maxwell's interests were multifaceted; his literary mind was as sharp as his scientific. By the age of eight, he knew the bible cover to cover and his "knowledge of Milton also dates from [these] very early times." "These things", Campbell writes, "were not merely known by rote. They occupied his imagination, and sank deeper than anybody knew."[14] Maxwell's early passion and talent for literature—he was able to intuitively grasp the nuances of other authors' works while also being adept at writing his own poetry—was recognised by the Edinburgh Academy who awarded him the scripture biography prize in his second year.[15] But perhaps the most important aspect of this early talent was that it developed alongside Maxwell's mathematical intuition and ability to think in geometrical terms.

[12] Campbell, *JCM*, p. 32.
[13] Ibid., p. 31.
[14] Ibid., p. 32.
[15] Basil Mahon, *Man Who Changed*, pp. 12-14.

In a letter to his father, Maxwell wrote, "I have made a tetrahedron, a dodecahedron, and two other hedrons, whose names I don't know."[16] Although he had never formally studied geometry, just after his thirteenth birthday Maxwell, 'discovered' the regular polyhedra. These are a class of highly symmetrical solid shapes with congruent faces and identical vertices (otherwise known as the Platonic solids).[17] He made models of each shape out of pasteboard and, more impressively, derived further symmetrical variations from each type. This is an early example of Maxwell's thinking through making. Particularly notable is how he was familiar with these shapes and understood their properties despite not knowing their names or having a formal description from which to work. In making these objects, he intuitively allowed input values to determine the output characteristics of related hedronic shapes, without necessarily grasping their specific geometrical properties.

Throughout his youth and later career, Maxwell made physical models to help concretise abstract processes: his colour and dynamical tops, his model to demonstrate the stability of Saturn's rings, his eight-foot long light box (which his London neighbours mistook for a coffin). In a manner similar to the construction of his pasteboard hedrons, Maxwell's models were sometimes constructed from, or to demonstrate, a system's general characteristics. The detailed mechanism at work behind the general process, however, was not necessary to know. In modern physics, a system or object viewed simply in terms of its function is known as a *black box*. A black box's internal processes are either obscured through a lack of information or considered unimportant. As Bruno Latour writes, when a system "runs efficiently … one need focus only on its inputs and outputs and not on its internal complexity."[18] What matters are the initial stimuli, their altered responses, and their relation to the smooth functioning of the system as a whole. It is worth retaining this conception of blackboxing because one of Maxwell's novel scientific approaches was to apply such an

[16] Campbell, *JCM*, p. 56.
[17] Mahon, *Man Who Changed*, p. 12.
[18] Bruno Latour, *Pandora's Hope: Essays on the Reality of Sciences Studies* (Cambridge, MA: Harvard University Press, 1999), p. 304.

approach to theoretical thinking. He would distribute the explanatory workload of a theory by importing key constituent inputs into a fictional model, which would then either produce, or fail to produce, testable outputs. Moreover, developing the eighteenth-century mathematician Joseph Lagrange's form of reductive differential analysis, Maxwell would begin to treat dynamical systems like black boxes, content to work only with inputs and outputs. Maxwell's pasteboard polyhedrons are formative example of this type of black boxing and this methodological practice would later be conjoined with poetic experimentation.

Soon after the construction of the Platonic solids, Maxwell was recognised as an outstanding talent; he subsequently won the Academy's end of year prize for English and poetry as well as the mathematical medal.[19] This intersection between mathematical and literary interests brought together language and mathematics with haptic manipulation: an approach that would define Maxwell's scientific career. However, partly because of this conflation of early interests, his exact thoughts on how science should be practiced are difficult to classify. On one hand, Maxwell thinks that scientific enquiry on its own cannot explain fully the vibrancy of nature. Not only an ever-evolving approximation of reality, it is also unable to account for the ultra-material, the numinous, the spiritual. On the other hand, the conjunction of scientific theory with theology, in the manner practiced by Stewart and Tait, is also viewed as inimical to the formulation of real truths. Throughout his later life, Maxwell was invited to join the Victoria Institute—an organisation founded to "investigate fully and impartially the most important questions of Philosophy and Science" by allying them with 'revealed scriptural truths'.[20] Maxwell was blunt in his rebuttal: "I think that the results which each man arrives at in his attempts to harmonise his science with his Christianity ought not to be regarded as having any significance except to the man himself."[21] Perhaps because of this wariness, Maxwell's analogical combinations did in

[19] Campbell, *JCM*, p. 70.
[20] *Journal of Transactions of The Victoria Institute*, (London: Robert Hardwicke, 1866), p. vi.
[21] Maxwell, *JCM*, p. 405.

fact have significance outside of his own beliefs, particularly in the strange entanglement of poetry and science. But more to the point, Maxwell's thought itself was both resolutely dynamical and analogical. He did not merely use analogies as a tool; analogies were interwoven with how he perceived the world.

3.2 Poetic instability and analogical transformation in 'A Vision'

By the time William Thomson had published his paper on dissipation in October 1852, Maxwell was still only a twenty-one year old undergraduate at the University of Cambridge. But he was already grappling with what he felt were deficiencies in mathematical training and pondering problems concerning the transformation, conservation and degradation of information, the spread of materialism and the potential for thought to move beyond the limitations of analytical reasoning. He approaches these problems with playful revelry in a satirical poem of 1852: 'A Vision: *Of a Wrangler, of a University, of Pedantry, and of Philosophy*'.[22] My reading argues that Maxwell's allegorical figure of Pedantry—a distillation of mechanical principles and analytical reason—is analogically mapped onto Milton's Sin in *Paradise Lost*. In the successful and unsuccessful transmission of poetic information between these two poetic constructs, Maxwell's poem suggests that epistemologies devoid of emotion and spiritual intuition and which are not open to change cannot accurately represent the dynamic complexity of reality.

Written in trochaic tetrameter, the poem recounts a hallucination experienced by its student protagonist during a night of exhaustive mathematical revision for the "fearsome" Tripos exam.[23] His body is cold and weary, particularly in the 'extremities'—"Fogs had stamped my torpid members, / Like a plucked and skinny goose." His mind

[22] As appears in *JCM*, pp. 612-18.

[23] As Basil Mahon explains, the Tripos exam was a grueling mathematical test that effectively determined which men would lead the country. Lifelong recognition was the prize for students who finished with first class honours. These students were known as 'wranglers' and were ranked by number: "to become senior (first) wrangler ... carried immense professional kudos." Mahon, *Man Who Changed*, pp. 42-43.

is similarly strained. "Confused and muddy" from "the effects of study", it conjures a series of hypnagogic visions related to university life and abstract mathematics: a subject he describes as "unblest." He first encounters the archetypal 'wrangler' who "lauds the education / Which has raised [him] to lofty station". This is a figure assembled on the Tripos factory production line. Dismissive of experimental thought and concerned only with "upholding that Convention / Under which his fortunes rose" he is the embodiment of "worldly Pride" and the singular belief in his own "powers of calculation".

Soon, "spectral forms" of campus life invade the room: "Little creatures" from "every college", the "modest Moderators", "College tutors – private coaches" and the "costly apparatus / That is meant to elevate us" to great "intellectual status". Appearing in a grotesque parade, the poem's speaker wonders if these collegiate gremlins are a mental regurgitation of the precepts drilled with "simple repetition" into his overworked mind. This steady procession of visions and the drudgery of learning by rote is mirrored in the poem's structure. Stanzas built of two quatrains with the rhyme scheme AAAB / CCCB and trochaic metrical stresses, build in increasing repetitive force over the first three lines, only to be subverted in the shorter fourth line. This structural quality also evokes the tension between creeping mental anguish punctuated by moments of rationalisation and, as Daniel M. Siegel points out, recalls Edgar Allan Poe's 'The Raven' (1845). For sure, the parallels between the poems are striking—metrically, rhythmically, thematically—and colour 'A Vision' with a certain gothic hue: from "the solitary narrator in his room at midnight, poring over his arcane books" to the "embers in the grate, flickering"; from the bleak winter season to the appearance of "grim, diabolical and domineering" apparitions.[24]

Yet the poetic tradition which 'A Vision' bears a more striking resemblance to is revealed with the dissolution of the university "creatures". In their wake, a ghastly

[24] Daniel M. Siegel, 'Text and Context in Maxwell's Electromagnetic Theory' in *No Truth Except the Details: Essays in Honor of Martin J. Klein*, eds. A. J. Fox and Daniel M. Siegel (Dordrecht: Kluwer Academic Publishers, 1995), pp. 281-99 (p. 283).

feminine apparition replaces them: a grotesque and singular embodiment of the university's conventionality, arrogance and pedantry. "Angular in form and feature, / Unlike any earthly creature", Pedantry's body is a composite of the paraphernalia associated with mathematical study: "Hair of pens and skin of paper; / Breath, not breath but chemic vapour", "Eyes of glass, with optic axes, Twisting rays of light as flax is". Through these "dull, unmeaning eyes", Pedantry sees a world where "all Nature / Seems reduced to meaner stature". Defined by Newtonian rationality, this is a world in which value inheres only in analytics: "algebra is the measure / Of that unexhausted treasure". She is the guiding impulse, Maxwell intimates, of the wrangler concerned only with the preservation of his own professional status and established lines of thought. With "hoarse devotion, she implores the fraught student to take care of "Number One" (a pun on the ranking of top wranglers): "As for Poetry", "Cut the thing entirely"; "Why not stick to what you're best on? / Mathematics always pays."[25]

Daniel Brown observes that Pedantry's appearance belongs to a species of "visual puns" originating in the baroque, "in which human faces and figures are composed of mechanical, industrial and consumerist artefacts."[26] But, more significantly, Pedantry is also the allegorical progeny of Milton's Sin: a daemonic personification herself rooted in a variety of pagan, Christian and Classical myths. The parallels between Pedantry and Sin abound, both in terms of their disjointed, particulate bodies and their allegorical and analogical function within each text. Maxwell bases his spectral embodiment of 'mechanised' thought and Cambridge's repetitive mathematical exercises on Sin, in order to tap into a rich source of interpretive hermeneutics. One of the reasons he does this is to comment on the relative value of knowledge and how the degeneration of information can be viewed in ambivalent terms. But he does so in a way that also encourages a form of active, doubled thinking from his poem's readers. This manifests as, on the one hand, the

[25] Maxwell was ranked second wrangler upon leaving Cambridge—an extraordinary achievement in its own right, but especially impressive given Maxwell's distaste for the limitations of Tripos mathematics.
[26] Brown, *Poetry*, p. 50.

serious contemplation of epistemological strategies of knowing and their relation to the ontological conditions of being; *and*, on the other the playful reading of interactions across mathematical, mythological and textual domains. Such cross-cultural relations are characteristic of both the "pun, [in which] two truths lie hid under one expression" and analogies, which connect "one truth discovered under two expressions".[27] Maxwell similarly encourages Pedantry to be read *emblematically* as a visual pun where a vast amount of doubled poetic information is compressed into a small space; and *intertextually* as an analogy, where meaning is determined by a correlational interaction across multiple terms. It is in such doubles—the 'two-in-one' of the pun, and the 'one-in-two' of the analogy—that Maxwell suggests we are able to more readily approach problems whose "solutions can be transposed by reciprocation" across branches of thought.[28] But it is also in *failures* of meaning, distances between origins and the confusion between informatic relations, that Pedantry functions and as anti-type pointing to what Maxwell sees as the fallacy of attempting to justify an absolutist principle (as Tait, Stewart and Tyndall all do) against change and degeneration. In other words, conservation *and* dissipation are programmed into the formal operations of Pedantry, and determine, with relative autonomy, her function(s) within the text.

In *Paradise Lost*, Sin appears before Satan at the gates of Hell, a pitiful figure who is both Satan's forgotten daughter and former lover. Having sprung from his mind in Heaven (an act of unholy parthenogenesis that parodies the immaculate impregnation of Mary and Athena's birth from Zeus's head), Sin engages in incestuous union with Satan. This transgressive coupling results in the conception of their son, Death, and the horrific distortion of her body, rendered by Milton in gratuitously graphic detail. The "formidable shape" of Sin, a "woman to the waist, and fair," whose bottom half ends in "many a scaly fold", finds its Maxwellian counterpart in the "awful form" of Pedantry, whose body is constituted by instruments pertaining to analytical study: paper, pens, optical lenses, vapour (II. 649-51). Such similarities are more than a

[27] Maxwell, *JCM*, p. 235.
[28] Ibid.

matter of appearance. In fact, the "strangely jumbled" constitution of both figures extends to their mythological heritage, which is convolutedly layered like the "scaly fold[s]" of Sin's body, or the "oddly placed" objects that form Pedantry. Sin's female torso and serpentine lower regions echo Spenser's 'Error' *in The Faerie Queen*—"Halfe like a serpent horribly displaide, / But th'other halfe did a woman's shape retaine"—whose construction is itself an amalgamation of Classical monsters (I. i. 14). More pertinently though, Sin and Error, being a mix of woman and serpent, are aligned with the 'draconcopes': a medieval depiction of the Edenic serpent but with the face, and sometimes arms and bust, of a woman. Pedantry, with her "tricks" promising "'Powers!'" and "the clearest notion" of "How to compass sure promotion" is similarly a personification of temptation. Her wily words encouraging the rejection of metaphysics and the adoption of a worldview predicated upon analytical reason alone feed into this vision of monstrous femininity, which is figured against the wider background context of 'viper-lore'.

Milton, moreover, compares Sin to the "night-hag, .../... riding through the air," while the narrator in Maxwell's poem recoils from Pedantry's witch-like form and motion: "As the Hag was thus proceeding / ... I was faintly pleading" (662-3). Both descriptions recall Hecate, goddess of the underworld and queen of the witches, along with more primitive visions of night terrors and demonic possession. Perhaps most notably, they also evoke Robert Herrick's 1648 poem, 'The Hag', with Maxwell's 'A Vision' echoing both the thematic and rhythmical qualities of that earlier work:

> The hag is astride
> This night for to ride,
> The Devil and she together[29]

Milton's reference to "Vexed Scylla" and the wild sea that separates the shores of Calabria and Trinacrian, meanwhile, calls to mind the geographical, "structural and

[29] Robert Herrick, 'The Hag' in *Select Poems from the Hesperides* (Bristol: J. M. Gutch, 1810), p. 167.

thematic proximity" of the Sirens (660-1).[30] In 'A Vision', Maxwell's narrator is horrified to "hear the Siren / 'Own' me thus with voice of iron". Here, Pedantry is compared to a Siren in more than nominal designation. The Homeric and Ovidian Sirens lure sailors to their deaths with their sweet, irresistible song. Pedantry's "voice of iron", however, is more akin to Alcman's description of the Sirens in *Louvre Partheneion*, who are endowed with "'voices with jagged (shark-like) teeth'".[31] It would be a great coincidence if Maxwell were not aware of Alcman's take on the Siren song. A second description of Pedantry's vocal qualities takes the aural metaphor of jagged teeth and converts it into a mechanical equivalent—the metal 'teeth' of a saw blade: "in tones approaching nearer / To a saw's", "the voice the spectre spoke in / Might be known by many a token / To proceed from metal, broken". Alcman's mutation of the Siren lore is thus further mutated by Maxwell, and placed in a mechanical context.[32]

Physically and mythologically, then, Sin and Pedantry are built from a multitude of source materials and parts. At a thematic level, this intertextual aggregation has a tralatitious function: it ties both figures to a wide literary heritage, suffusing their depictions with biblical, pagan and classical images of monstrous, deceitful femininity that have been culturally transmitted over time. In Maxwell's poem, this is less problematic than it is contrived. A cautionary tale in which a spiritual man is led astray by a feminine spectre embodying questionable values is hardly original (Pedantry offers the narrator a sort of Faustian pact: adopt Cambridge's rigid

[30] Marianne Govers Hopman, *Scylla: Myth, Metaphor, Paradox* (Cambridge: Cambridge University Press, 2012), p. 109.
[31] Hopman, *Scylla*, p. 109.
[32] The mechanized siren, used to embody concepts such as scientific arrogance, the false dichotomy between reason and faith, and the tempting allure of populist scientific sensationalism, reappears in Maxwell's later poem '*A Tyndallic Ode*'. As the previous chapter suggested, the poem satirised Tyndall's demonstrative flamboyance and accused him of turning transient impressions into deterministic facts. Here, the Siren is similarly composed from an assortment of objects and physical phenomena and plays a similar role to Pedantry in 'A Vision': a beguiling temptress without any real, metaphysical and truthful substance: "What means that thrilling, drilling scream, / Protect me ! 'tis the siren: / Her heart is fire, her breath is steam, / Her larynx is of iron", *JCM*, p. 635. The siren directly references one of Tyndall's papers that discussed the transmission of sound. But the most striking resonance is the similarity it bears to the description of the siren's voice in 'A Vision'. In the earlier poem it "proceed[s] from metal, broken; in '*A Tyndallic Ode*', "[h]er larynx is of iron". The continuity between descriptions suggest Maxwell was familiar with Alcman's sirens, whose "iron" voices represented a stylistic departure from their more commonly depicted angelic tones.

mathematical doctrine above all other forms of knowledge and be guaranteed a life of wealth and intellectual security). But it is a lesson he nonetheless would have been justified in thinking his fellow Cambridge Apostles would recognise. Indeed, the intellectual fertility of the Apostle's club was such that Maxwell more obviously offsets it against the university's prevalent "domain of error" in a poem penned in 1853.[33] Here, "Pedantry is [still] in demand!" but she is a pale imitation of the spectre in 'A Vision'. Though prevalent among the university's "haughty Schools", Pedantry is more readily dismissed by the values of the Apostles, which allows them to survey "the opening mysteries / Scattered around them ever." The "imaginative world of the Apostles" was thus a place where "Classics and mathematics worked together in a common literary culture" and where Maxwell was able to frame his arguments in a context conjoining science with "humanity's imaginative past."[34] A place where analogous allegory clothed in mythological garments could speak to a scientific subject.

And yet, something about this analogical relation between Maxwell's Pedantry and Milton's Sin does not work. There is of course a playful irony in the fact Pedantry implores the narrator to shun poetry and myth, yet is herself constituted by these textual components. But as an allegorical figure, she sits awkwardly against her own poetic constitution, the allusions failing to cohere. It is as if the deterministic schema she implores the narrator to uphold does not function properly when processing information that is anything other than raw mathematical data. Symbolic failure is a feature of Milton's Sin too. Both his and Maxwell's figures are, in their own way, grossly excessive yet still somehow total less than the sum of their parts. Their heterogeneous constitution suggests not an interweaving of poetic ideas but rather, a discontinuous collection of disparate pieces. This failure is partly the point. Pedantry's senses, for example, are not relational; they are restricted to specific organs. She embodies not an

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[33] The poem, using the same trochaic tetrameter and stanza construction, bears the antipoetic title, 'Lines written under the Conviction That It is Not Wise to Read Mathematics in November after One's Fire Is Out' (1853). *JCM*, pp. 622-25.

[34] W. C. Lubenow, *The Cambridge Apostles, 1820-1914: Liberalism, Imagination, and Friendship in British Intellectual and Professional Life* (Cambridge: Cambridge University Press, 1998), p. 23.

expansive vision but a reductive one, both in terms of her physical construction and her mathematical outlook. Through her "dull, unmeaning eyes", "Nature / Seems reduced to meaner stature"; "If you had them you would hate your / Symbolising sense of sight." Pedantry's perceptive organs gather data whose value is purely analytical. Isolated from symbolic or spiritual interpretation, this information, rendered in a purely mathematical framework, is a mechanically reductive approximation of nature's complexity. She, and by association, the Tripos wranglers, thus only see the "planets in their courses / Thick beset with arrowy 'forces'".

These 'arrowy' vectors, and the implicit criticism of the term force, crop up again in Maxwell's poetry—as the previous chapter mentioned, namely in his poems parodying Tyndallic molecularity and the 'forcefulness' of Tyndall's public character. Here though, long before his professional career had been established, Maxwell was already associating 'force' with an antiquated rationalist philosophy *and* characteristic of fallacious analogical thought, i.e., *forcing* concepts together and drawing equivalencies that are false or restrictive. In the Newtonian derived Tripos mathematics, 'force', is understood in terms of its ability to act externally upon material objects. It is a concept defined by directionality ("arrowy"), predictability, and proportionality, as in Newton's second law: *ma=f*, or, *the mass of an object times its acceleration is equal to the force acting on the object*. But force, in both its mathematical definition and terminological usage, is at this point in the 1850s a concept very much in flux. And it is a concept for Maxwell that, when considered as a causal actant outside of matter, is somehow lacking. Planetary motions are simplified under mechanistic epistemologies that shun the numinous and dynamical and treat force merely as a vital 'thing'. Force, linguistically and technically, has lost its 'forcefulness' as a concept. It is, to use a phrase from one of Maxwell's later poems, an "Impotent spectre" presiding over a collapsed domain where "Action and Reaction are now gone."[35]

[35] From Maxwell's 1876 poem, "Report on Tait's Lecture on Force: B.A., 1876". *JCM*, pp. 646-49.

The ‘force’ of Pedantry to convince as an allegorical figure, under which metaphorical and transitional meanings are unified, is also paltry. Her own “*arrowy* forces”—that is, being able to provide directionality, proportionality and equivocality to ‘pieces’ of disparate information—have ‘lost their sting’. She herself is an “Impotent spectre” held by the narrator “in calm derision” and it is the force of his own convictions—“Nature more than symbols prizing”—that emerges victorious. Pedantry thus embodies the epistemological disjunct between dogmatic schemata and complex reality, precisely because her jumbled body parts (paper skin, hair of pens, vapour breath, lenses for eyes, iron voice), mixture of “myths from other days” (Siren, Hag, draconcopes), and poetic sources (Poe, Milton, Herrick, Alcman), fail to unify. It is in this respect that Pedantry’s simulacral relation to Sin is most notable. Milton’s figure is also a reductive vision, less than the sum of her parts. His descriptions of Sin are thick with the semantics of repetition and cyclical regression, imparted through stresses on ‘in’—“*in*flamed”, “*in* embraces”, “*In*gendering”, “*in*finite”—and the homophonic parallel between ‘maid’ and ‘made’, in “dismaid”: a pun that comes to literally mean dis-*made*. Coupled with the multitude of overlapping mythological allusions, these components form an ironic ancestry. Sin is a grotesque genetic mutation whose inherited traits are abundant yet meaningless. Traditional literary signifiers are themselves hybridised to create (or mis-create) mutations in signification, while Sin’s varied mythological origins contend with the fact that she was born from Satan’s mind. His “creation” of her was simply a parthenogenetic *re*creation of *himself*. As such, Sin is positioned as historically prior to the mythological monsters she is built from—Scylla, in other words, is derivative of Sin. Yet at the same time, Sin herself is only an image: a copy of a copy, a derivative of another deferred origin, whose meaning is non-indexical: “call’d me *Sin*, and for a Sign / Portentous held me” (759-60). In this way, Sin is uncreated. She is built from, and propagates an abundance of, poetic ‘noise’: yet this noise is aporic because, in Milton’s view, the only true source of meaning is Godly.

Sin, then, is an incestuous circuit, whose confusion of parts produces a parodic simulacrum of both epistemological and ontological relations. Maxwell's Pedantry is the same. She is no more an 'original' allegory than Sin, a mere "artificial spectre" who proves to be "a paltry sub-collector, / And had nothing to connect her / With the being whom she aped." She is, Maxwell's narrator infers, discontinuous and fragmented. Information is not meaning, aggregation is not being. The failure of Pedantry as a unified figure thus works to complicate Maxwell's two central concerns at play in the poem. *First: how do we come to know the world given that our senses are limited, and man-made scientific theories are constantly changing?* Maxwell is not saying that his own view, that mathematics is only a part of knowledge, is infallible. But he does think there are gradations of value in epistemological constructs. Schemas like those espoused by "the learned crowd" of wranglers are inferior to those more akin to the Apostles, whose view of nature is collaborative and analogical. The Apostles combine the analytical with the numinous, the scientific with the poetic, to form a "symbolising sense of sight". Along with the scientific, there has to be a "moral foci where the true image of the original act is reproduced" in as close an approximation to the mysteries of nature as possible.[36] Thus, for Maxwell, an increase in knowledge is not synonymous with the technological progression of scientific instruments. Microscopes, telescopes, the paraphernalia of measurement and advanced mathematic notation: these tools can provide us with ever-more information, but processing this information and using it to think experimentally is another process entirely. And as such, epistemology must follow the lead of nature: it must be open to change, unstable not rigid, but still housed within a mental framework that "Sees the glories of Creation" without, as Stewart and Tait do, *forcing* analogies between theology and science.

The second problem brings us back to Maxwell's concern with what things are and how they work: *what's the go o' that?* Pedantry's failures mark her, like Sin, as poorly constructed: an 'artificial spectre', a discombobulated machine. Her parental

[36] Maxwell, *JCM*, p. 242.

lineage, like Sin's, is similarly confused and incestuous. Though a product of the narrator's imagination, she attempts to position herself as *ur*, the source from which cognitive and ontological certainties are formed: "my son" she repeats throughout her encounter with the poem's student. The confusion here is surely intentional. Pedantry, seeing her body comprised of bits and pieces, a sub-collector of things, mistakenly identifies herself as primary. But an atom does not make a person any more than a lens makes an eye. Break the human down into ever-smaller components, limbs, joints, tissue, nerves, molecules, atoms, Maxwell implies, and you still will not be able derive being from matter, consciousness and free will from *stuff*. The same is true of Pedantry. Her excessive poetic and mythological components do not automatically make her a functioning, unified and meaningful poetic figure. To take this view is to deal simply with forces of attraction—between matter, or between texts. "Force ... is a scientific word, signifying something which always meets with opposition" but it cannot be confused as primary: as giving direction to the principles "which regulate the *right* process of the intellect ... necessary truths" and "the other laws of thought."[37] Force, as energetic principle acting within material bits, can organise. But it cannot create being and cannot compute information into meaning, in the way that Tyndall's atomic architect does. Molecular forces might produce complex structures like salt crystals but they cannot create the spark of consciousness in the brain.

Pedantry is thus merely a type, a copy of autonomous individuality whose particulate aggregation makes her no more a real, thinking being than Hobbes' Leviathan—"a monster ... stuffed with men" yet whose excessive social body is inherently reductive.[38] For Maxwell there are other, more intensive 'forces' at play: forces of *will* and *consciousness* and *ethical intuition* that cannot be reduced to material parts. This understanding is arrived at through a fluctuating form of poetic analogy. By drawing relational equivalencies between Pedantry and Sin, Maxwell is able to postulate complex ideas about the value and decay of information, forms of

[37] Maxwell, *JCM*, pp. 239-40.
[38] Maxwell, 'Psychophysik', *JCM*, pp. 452-63 (p. 458).

inquiry and thought, and the make-up of matter, in a manner that has a more subtle and dynamical quality than merely explaining these ideas in sterile prose. 'A Vision' thus performs a type of blackboxing. Maxwell fixes a set of inputs and allows the complex poetic interactions between these terms semi-autonomously to generate a set of outputs. How they emerge from the text, depends in part on the "symbolising sense of sight" readers bring to bear on the poem, forging a new open system. For Maxwell, new meaning does not emerge from what is predictable, disconnected and identical but from the dissonant, interrelated and differential. Even though he was a young man, Maxwell was thus already seeing the productive, negentropic value of analogical thought when freed from purely phenomenological grounds. "[I]f we only maintain the existence of the analogy" Maxwell once explained, "and allow observation to determine its form, we cannot be led far from the truth."[39] It was a maxim that became even more prominent in his later life.

3.3 'Psychophysik', and the problem of ontological continuity

When the Eranus club met on the 5th February 1878, Maxwell delivered a lecture titled 'Psychophysik': a refutation of what he saw as materialism's reductive approach to free will and consciousness.[40] The title refers to G. T. Fechner's suggestion that subjective experience was reducible to biochemical processes. A second theory 'Psychophysik' argues against is the German biologist Ernst Haeckel's 'plastidules': microstructures found within the protoplasm of living cells, whose vibrations transferred hereditary information and evolutionary 'memory'. Each vibration of the plastidule was "a result of its history and environment, which constituted memory for the organism and heredity for the species."[41] At the moment of conception, the cumulative mass of these

[39] *JCM*, p. 243.
[40] The Eranus Club in Cambridge was a debating society modelled on the Cambridge Apostles.
[41] Robert Michael Brain, '*Protoplasmania*: Huxley, Haeckel, and the Vibratory Organism in Late Nineteenth-Century Science and Art' in *The Art of Evolution*: Darwin, Darwinisms and Visual

vibrations was transmitted through sperm and egg to produce a body ‘imprinted’ with its ancestors’ “conditions of existence.”[42] For Maxwell, these ideas “raised difficult issues about the nature of the human will.”[43] But alongside his critique of mechanical determinism, Maxwell also mocks Tait and Stewart’s fallacious reasoning in *Unseen*.

The essay opens with the following questions: “What used I believe about myself? what is it likely I shall have to believe about myself? and what should I believe about myself now?”[44] Philip L. Marston claims Maxwell intended these lines to recall the philosophical discussion between Adam and Raphael in *Paradise Lost*: “[he] could well assume all of his listeners were familiar with words Milton put in the mouth of Adam”.[45] In support, Marston quotes the specific lines that he claims Maxwell had in mind: “how came I thus, how here? / Not of myself; by some great Maker then, / In goodness and in power preeminent …” (VIII. 277-9). Beyond this, however, Marston does not elaborate on the potential meaning of this allusion.

These lines from *Paradise Lost* describe Adam’s growing awareness of his own creation. Philosophising with Raphael, the angel warns him not to let the quest for earthly knowledge become transgressive: “Solicit not thy thoughts with matters hid … / be lowlie wise:” (VIII. 167; 173). With this gentle admonishment, Adam turns his thoughts to the emergence of his consciousness: a process which, according to Geoffrey Hartman, leads to the recognition of “ascending order and reciprocity” in the cosmos.[46] As such, Adam engages with his material surroundings in a manner that understands the limitations of his own “lowlie” wisdom. Careful introspection leads to knowledge of the self but also God’s divinity.

Culture, eds. Barbara Larson and Fae Brauer (Dartmouth: Dartmouth College Press, 2009), pp. 92-123 (pp. 97-98).

[42] Ibid., p. 98.

[43] Matthew Stanley, *Huxley’s Church & Maxwell’s Demon: From Theistic Science to Naturalistic Science* (Chicago: University of Chicago Press, 2015), p. 196.

[44] Maxwell, ‘Psychophysik’, p. 452.

[45] Philip L. Marston, ‘Maxwell, Faith and Physics’, in *James Clerk Maxwell: Perspectives on his Life and Work*, eds., Raymond Flood, Mark McCartney and Andrew Whitaker (Oxford: Oxford University Press, 2014), pp. 258-91,(p. 279).

[46] Geoffrey H. Hartman, *The Geoffrey Hartman Reader*, eds. Geoffrey H. Hartman and Daniel T. O’Hara (Edinburgh: Edinburgh University Press, 2004), p. 81.

If Maxwell intended the group of former Cambridge Apostles to hear the opening of 'Psychophysik' in this context, the implications are resonant. Maxwell frames his argument in light of the Adamic model of intellectual curiosity. Study of the physical world is not at odds with faith, nor does it lead to the conclusion that "I shall have soon to believe myself to be a congeries of plastidule souls … to obtain a true knowledge of myself."[47] However, faith and science are still domains that demand careful circumscription. Both branches of knowledge can overlap and furnish the other with nuance; but the justification of a theological principle on scientific grounds, or vice versa, can produce absurdities. Furthermore, by invoking the evolution of Adam's consciousness, Maxwell implies more generally that the postulation of continuity between ontological and epistemological realms is erroneous. The operations of thought and matter intersect but they are not analogical. Indeed, in a review of *Paradoxical Philosophy* (1878), Stewart and Tait's sequel to *The Unseen Universe*, Maxwell reiterated this claim.[48] His review draws heavily from 'Psychophysik', similarly framing its attack against both reductive materialism and reductive theological speculation. In both contexts, attempts to treat consciousness and the soul as "something objective that we could reason about" are misplaced: "as soon as we plunge into the abysmal depths of personality we get beyond the limits of science".[49]

However, although I agree with Marston that Maxwell invokes *Paradise Lost*, the lines he references do not quite work. In fact, the essay's opening questions more readily echo Adam's description of his *confusion* just after waking: a moment that occurs structurally in the text only a few lines before his hymn to Nature but epistemologically, a great distance apart. Though Adam is able to move, his capacity for thought is limited: "But who I was, or where, or from what cause, / Knew not" (VIII. 270-1). The tripartite structure of Maxwell's questions evokes the three variables of Adam's confusion, *who, where, what*. Following Ricoeur's theory that personal

[47] Maxwell, 'Psychophysik', p. 452.
[48] Maxwell, 'Review of Paradoxical Philosophy' in *Sci Papers II*, pp. 756-62.
[49] Maxwell, 'Psychophysik', p. 462.

memory functions *counter* to historical linearity, Elizabeth Sauer argues that Adam's changing memories deconstruct a definitive creation narrative. His "recollection of events", she writes, "displaces the origin and the ur-history with the multiple, even 'unauthorised,' creation accounts in the poem."[50] Indeed, memory in *Paradise Lost* undermines the idea of an unbroken, linear transfer of knowledge. Satan, for example, forgets his creation of Sin and wilfully misrepresents the war in heaven.

Likewise, Maxwell draws an analogy between *Paradise Lost*'s unstable narrative of origins and the deterministic genetic history posited by plastidule theory. Mechanical memory is essential to the operations of plastidules, whose vibrations record past environmental changes and transmit this information through organisms. As Maxwell writes, certain thinkers believe mechanical "memory [is] a faculty ... essential to the continuity of the Ego in time."[51] To refute this idea, Maxwell plays contrarian and ironically adopts the naturalist perspective. "[W]e are tempted", he writes, "to ask whether all memorials are not of the same kind—a physical impression on a material system."[52] For example, he suggests, Thomas Edison's 'Talking Phonograph' "has an ear of its own, into which you may say your lesson, and a mouth of its own, which at any future time is ready to repeat that lesson."[53] Like Pedantry, the mechanical components of the phonograph are figured as organs. Its 'memory' "consists of tinfoil thin enough to be impressionable by the metal style which is set in motion by the voice, yet thick enough to be retentive of these impressions". A conundrum is put to the audience: this material is the "heart of this instrument ... Are our own hearts essentially different?"[54]

Maxwell partially agrees with the naturalist view that our memories have a physical aspect and that in this respect, they share an ontological connection with the 'memory' of the phonograph. But Maxwell shows the analogy is flawed. Memories can

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[50] Elizabeth Sauer, *Barbarous Dissonance and Images of Voice in Milton's Epics* (Kingston: McGill-Queen's University Press, 1996), p. 104
[51] Maxwell, 'Psychophysik', p. 458.
[52] Ibid., p. 455.
[53] Ibid.
[54] Ibid.

"be all wrong"; they can shift and change, and it is from these imperfections that individuality arises. Like Adamic memory, heterogeneity undermines the construction of a single historical lineage.[55] Moreover, the phonograph, a machine with supposedly "thinking" components, is in no way analogous to human consciousness. It does not 'talk' because what it says has already been pre determined. And like Pedantry, the phonograph collects information but has no 'symbolising sight' with which to interpret it. Indeed, Maxwell argues, if impressions "received by the senses … go no further than the places at which they are received … they are useless."[56]

Working alongside Maxwell's anti-determinist argument is also a criticism of Stewart and Tait's analogy between human and ethereal memory. In his review of *Paradoxical Philosophy*, Maxwell mocks the "conviction of the perpetual validity of the 'Principle of Continuity,'" and the notion "that if at any place or at any time a single exception to that principle were to occur, a general collapse of every intellect in the universe would be the inevitable result."[57] Similarly, in a satirical poem addressed to Hermann Stoffkraft, the fictional hero of *Paradoxical Philosophy*, 'ethereal memory' is cast as a pseudoscientific fantasy: "Great Principle of all we see, Unending Continuity! By thee all our angles sweetly rounded".[58]

Maxwell's response to these problems is similar to the interplay between ideas in 'A Vision'. In both texts, poetic analogy is not unidirectional and fixed, but unstable and even contradictory. These counter arguments are incredibly subtle. But they are arguments Maxwell would have expected his audience to follow. Total analogical harmony suggests that far from functioning properly, analogy is being forced to fit a pre-existing framework. As he elsewhere writes, often "the resemblances between the laws of different classes of phenomena should hardly be called analogies, as they are only transformed identities."[59] This is almost the exact same critique that Deleuze will

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55 Ibid., p. 456
56 Ibid., p. 461.
57 Maxwell, *JCM*, p. 758.
58 Maxwell, 'A Paradoxical Ode' in *JCM*, pp. 649-51 (p. 650).
59 Maxwell, *JCM*, p. 241.

later make: the indeterminacy of reality is restricted by the representational limitations of analogy. But for Maxwell, there is a slight difference. Fixing the terms of analogous enquiry and presupposing a conclusion is the problem. If an analogy is already constructed with a final cause in mind, it is likely to be simply a 'transformation of identities'. Looking back at Stewart, Tait and Tyndall's thermodynamic narratives, it is plain to see that their 'entroped' speculations have little basis in fact but are fantastical fictions conjured from personal belief. Maxwell is unequivocal on this point. In an 1855 essay he claims: "If … we start from the study of the laws … then these apparent analogies become merely repetitions by reflexion of certain necessary modes of action to which our minds are subject."[60] But "if we only maintain the existence of the analogy, and allow observation to determine its form, we cannot be led far from the truth."[61] For Maxwell, an analogy can therefore be treated as a black box: import a set of inputs and let them determine what the output information is, and how it is produced.

Precisely how this information is transmitted—and whether or not it is subject to degradation—is essential to Maxwell's philosophical liberation of free will. While the dominant paradigm in Victorian Britain regarded information as something which could be accumulated, categorised and used to create an ever-expanding base of knowledge, some also began to see it in more ambivalent terms. A few, such as William Francis Barry and Francis Galton even began to consider information as in itself entropic. Rather than expanding knowledge, an excess of information could make it increasingly degraded. It is from this view of information *as* entropy that Maxwell develops a notion of negentropic free will. But to understand how he reaches this point we first must explore Barry and Galton's entropic information.

[60] Maxwell, 'Is Ethical Truth obtainable from an Individual Point of View?' in *JCM*, pp. 234-44, (p. 241)
[61] Ibid., p. 243.

3.4 Barry and Galton's entropic information

In 1948, an engineer working at the Bell Telephone Laboratories named Claude Shannon published a paper that would establish a new discipline: information theory. The paper addressed the problem of 'noise' in communications—errors in coding or electrical transmissions that could disrupt the content of a message—and proposed that information could be quantified in units called *bits*. From Shannon's formula measuring the overall distribution of bits in a message arose a curious implication: his definition of information saw it as analogous to entropy. Prior to this, it had generally been assumed that information and entropy were opposites. Information implied the order and unification of meaning while entropy denoted disorder and randomness. Information, in other words, was considered negentropic because it resisted entropy.

But Shannon's formula suggested otherwise; randomness and disorder could also be viewed as measures of information. For example, a shuffled deck of cards has greater entropy than one ordered by suit and numerical value and so picking a card from the shuffled deck is a more uncertain act. Crucially, information for Shannon was defined by this "freedom of choice when one selects a message"; "greater freedom of choice, greater uncertainty, greater information go hand in hand." [62] In this formulation, "noise acquires a paradoxical complexity, since it appears to be both what impedes the transmission of information and what is not yet coded as information."[63] Indeed, noise, in terms of its qualitative value, becomes an ambivalent quantity: it is both inimical to the transmission of a message and/or can produce new information "selected out of a greater set of possibilities" than the intended message.[64]

Although this connection between entropy and information emerged in the twentieth century, the theory has its roots in the Victorian era. It is worth considering

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[62] Claude Shannon and Warren Weaver, *The Mathematical Theory of Communication* (Urbana: University of Illinois Press, 1964), pp. 18-19.
[63] John Johnston, 'Technology' in *Critical Terms for Media Studies*, eds. W. J. T. Mitchell and B. N. Hansen (Chicago: University of Chicago Press, 2010), pp. 199-216 (p. 201).
[64] Ibid., p. 201.

these ideas in more detail because they show how attitudes to the value of knowledge began to shift and thermodynamic concepts encroached on entirely new areas of thought. Moreover, from these discussions developed one of Maxwell's most potent analogies: the demon. Among those who did see an analogous connection between entropy and information, however, noise was almost always considered in negative terms. It is only with Maxwell's intervention, and his connection of these debates to the Miltonic cosmos, that the notion of noise as ambivalent gains traction.

The increasing accumulation of junk information was of great concern to William Francis Barry: a Catholic apologist and critic of scientific materialism. Many of his essays warn of the dangers of 'foreign thought' and allude to what he sees as a more pervasive "cycle of change" characteristic of the general "spirit of the age".[65] As such, Barry was also hostile to texts like *The Unseen Universe* and attempts by Christian scientists to interweave science and theology. What is noteworthy about his essays is that they nonetheless make use of entropic tropes, suggesting a cultural diffusion of thermodynamic concepts into his own work.

In 'Mr. Tyndall and Contemporary Thought' (1876), Barry sees the proliferation of 'noise'—new scientific theories, philosophies and the 'rediscovery' of Classical texts—as bringing about the destruction of moral order. This increase in 'degraded' information is figured as a cacophony of foreign tongues: a "Babel of voices in European thought".[66] Unable to resist the influx of waste information, established modes of thought—"the fixed arrangement of thesis and anti-thesis"—give way to a mass of "undigested knowledge" and "the profuse chatter of a thousand journals".[67] Thus, fears Barry,

> we shall have learned a lesson of confusion; – that regions are many, and peoples various, and beliefs, in their way of interpreting life, discordant. Our watches and clocks will have lost their

[65] William Francis Barry, 'Mr. Tyndall and Contemporary Thought', *Dublin Review*, 27 (1876), 431-69 (p. 432).
[66] Ibid., 'p. 434.
[67] Ibid., p. 432; 436.

immediate use, for how can we make out the moments of sunrise and sunset? and without this, things that had a meaning now have none. The more information of this kind a man gains, the less he is master of his thoughts. Second childhood comes before its appointed hour, the world is unintelligible, a mere spectacle of idle richness and entanglement of growth.[68]

Here, the watch, that steadfast object of natural theology, becomes disconnected from the workings of nature, ceasing to function as a symbol of designed, intentional order. Moreover, the influx of various peoples and beliefs begets a proportional degradation of national identity, loss of free will and inability to control knowledge. Hence, epistemological entropy will become the natural order as previously stable theological traditions "end in darkness … in a depressing landscape, where sun and fog are mixed up till the paths disappear under contradictory lights."[69]

In this construction, information is not synonymous with knowledge; non-Catholic information has a negative value. Barry thus fears a world where the ever-growing accumulation of waste information becomes so abundant that it overwhelms traditional knowledge. This goes against the more pervasive trend in Victorian Britain to conceive of information as having intrinsic economic, social and imperial value. As Thomas Richards notes, "the last quarter of the nineteenth century saw the formation and consolidation of an imagined organon of global knowledge and power"; "an early version of today's fantasies of a world unified by information."[70] Here, information equals order while entropy, disorder. But Barry sees information as noisy in the negative sense: it serves to disrupt communication and proliferate confusion. Composed of discrete bits, information must be categorised, assembled or discarded, requiring the expenditure of human effort. Moreover, the production of information wastes paper, ink, mechanical power and the attention of readers while more generally threatening mastery over knowledge and eroding the notion of a single, authoritative

[68] Ibid., p. 433.
[69] Ibid., p. 442.
[70] Thomas Richards, *The Imperial Archive: Knowledge and the Fantasy of Empire* (London: Verso, 1993), p. 73.

set of moral and spiritual truths. But above all, Barry's fear of information was that it was inherently disordered and prone to exponential self-perpetuation.

A similar connection between information and entropy appears in the work of Francis Galton. A cousin of Darwin, Galton was a believer in biological determinism, a strand of evolutionary thinking which held that individual personality and collective cultural traits were genetically determined. After reading *Origin*, Galton became fixated with the idea that 'inferior' traits could only be expunged from the social body by admitting to the state "control of human breeding to produce genetically superior people".[71] Without intervention, the multiplication of junk genetic information would increasingly degrade the pool of high quality genetic material. Indeed, left to their tendencies, "the millions of all Europe, breeding as they have done" would bring about the destruction of ordered society.[72]

However, like Stewart, Tait and Tyndall, Galton proposes that this trend can be countered by a power external to the natural system: the interventionist efforts of the state. With the "introduction of differential reproduction regimes to prevent less able members of society from swamping more able members by their spontaneous reproduction patterns", the amount of waste in the social system can be reduced.[73] However, while the repression of negative traits does have a role to play in the improvement of society's "stock", by the turn of the century, Galton was broadly arguing for a 'positive eugenicist' movement: a theory primarily concerned with "improving the race of a nation" by "increasing the productivity of the best stock" through affirmative action.[74]

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[71] Robert Wald Sussman, *The Myth of Race: The Troubling Persistence of an Unscientific Idea* (Cambridge, MA: Harvard University Press, 2014), p. 50.
[72] Francis Galton, *Hereditary Genius: An Inquiry Into Its Laws and Consequences*, (London: Macmillan and Co., 1869), p. 342.
[73] Steve Fuller, 'A Tale of Two Narratives: Prolegomena to an Alternative History of Library and Information Science' in *European Modernism and the Information Society: Informing the Present, Understanding the Past*, ed. W. Boyd Rayward (Aldershot: Ashgate Publishing Limited, 2008), pp. 59-74 (p. 67).
[74] Francis Galton, *Essays in Eugenics* (London: The Eugenics Education Society, 1909), p. 24.

Galton's positive eugenics is essentially a conservative solution to an entropic problem. By selectively "increasing those who will become the lights of the nation", he aims to create greater efficiency within the system. Indeed, Galton's notion of 'degradation' taps into the thermodynamic moralisations already popularised by Stewart, Tait and Thomson. In *Hereditary Genius*, the associative force of the term is carried over in Galton's 'gradation' of traits derived from the quality of genetic information inherited by a given race, class or individual. These traits he imputes into a hierarchical taxonomy of higher (better) and lower (de-graded) qualities. For instance, in his classification of idiocy, the "Australian type is at least one grade below the African negro."[75] Dissipation is also used numerous times throughout the book as an arbiter of personal morality. In his assessment of distinct historical personages, Galton writes of one statesman, "[he] was studious, but at the same time a dissipated dandy"; of no less than Emperor Titus of Rome, "In his youth he was somewhat dissipated"; novelist Henry Fielding: "was very dissipated, and reckless in money matters"; Theodore Hook: "His constitution was naturally excellent, but he ruined it by dissipation", and so on.[76] Of course, Galton' language still draws on the older, pre-thermodynamic notions of dissipated habits. Coupled with biological determinism, however, the term also becomes connected with the material notion of entropy. In each of these instances, inherited greatness is compromised by a genetic disposition to moral decay and thus society left to its own natural tendencies propagates degraded hereditary information.

Hence, Galton is not concerned with dissipation on a local scale but its overall cumulative effect. "If there be such a thing as a decided law of distribution of genius in families," he claims, "it is sure to become manifest when we deal statistically with so large a body of examples."[77] Like Barry, Galton was concerned that exponential increases in low quality information would eventually overwhelm high quality genetic

[75] Galton, *Genius*, p. 339.
[76] Ibid., p. 113; 165; 175; 234.
[77] Ibid., p. 316.

'heat sources'. The "minds of men", Galton writes in 1883, "degrade into servile imitators and submissive slaves the past"; "no less than 540 individuals of Jukes blood … degraded into criminality, pauperism, or disease."[78]

But although Galton employs the same semantic register as Barry, his work is more scientifically thermodynamic. Using the German mathematician Carl Friedrich Gauss's law of normal distribution, Galton was able to condense "information concerning large groups of allied facts into brief and compendious expressions suitable for discussion".[79] By mathematically analysing deviations from the average, Galton believes a practical solution can be found to improve the overall efficiency of the social system. This is the advantage of the Gaussian distribution law. It takes huge quantities of discrete information and plots them against an overall average. Using the distribution model, Galton was able "to form a standard whence deviations towards any particular sub-type may be conveniently gauged."[80] And in so doing, he could easily pinpoint individual weaknesses—a certain class or group of peoples, for example—in the social system.

This concern with *general tendencies* is what most closely links Galton's work to thermodynamics. Indeed, as sociologist Steve Fuller argues, the "[t]wo emerging disciplines where such 'tendencies' mattered were eugenics and thermodynamics"; "both now operated in an intellectual context where individual people or atoms appear not in their unique embodiments, but as values taken by variables in a mathematical function."[81] Galton thus applied a quantitative methodology to genetics to make a qualitative claim. Anticipating the concepts of bits, his work also measured how discrete genes relate to the wider genetic pool: a system that is increasing in informational complexity and thus entropy. But unlike the ambivalent value of noise in Shannon's formulation, Galton sees genetic noise as having a negative value. Moreover,

[78] Francis Galton, *Inquiries Into Human Faculty and its Development* (London: J. M. Dent & Sons, 1907), p. 129; 44.
[79] Ibid., p. 33.
[80] Ibid., p. 239.
[81] Fuller, 'Two Narratives', p. 67.

without the introduction of external forms of energy in the form of state intervention, free will is negated by the deterministic tendencies of the overall social system. Natural laws drive the human mind while strict biological determinants set the limits on potential. If a human receives a measure of noisy genetic information, there is no way s/he can become a 'genius' in the face of dissipated characteristics. 'Greatness' has to be forcefully introduced into the system over a number of years. As Galton writes in an 1870 article published in *Macmillan's*:

> Our present natural dispositions make it simply impossible for us to attain this ideal standard [of a unified, great nation] … The hereditary taint due to the primaeval barbarism of our race, and maintained by later influences, will have to be bred out of it before our descendants can rise to the position of free members of a free and intelligent society.[82]

For Galton, attaining "this ideal standard" thus constitutes a continual struggle against the "natural dispositions" of man. Interventionist programmes are the only conceivable way to achieve this prerogative, as left to its own tendencies society will negate personal freedom. Hence, disorder is conceived as a having negative value because it increases the social system's overall dissipative tendencies.

Yet, it is from the connection Barry and Galton make between entropy and information that Maxwell stages an intervention into this debate, inadvertently stumbling across a way to destabilise deterministic systems. The following section explores the surprising ideas Maxwell encountered when using statistics to consider problems of a dynamical nature. These problems were directly related to the science of evolution, thermodynamics and Galton's eugenics. But they were also problems at the forefront of Milton's mind when he was writing *Paradise Lost*, a poem concerned with the metaphysical quandaries of men and demons. In the construction of his own demonic heuristic, Maxwell would destabilise the supposed immutability of the second law, without having to appeal to unscientific speculation. Indeed, the 'demon', an

[82] Francis Galton, 'Gregariousness in Cattle and Men', *Macmillan's Magazine*, 23 (1870), 353-57 (p. 357).

omniscient fictional being occupying the liminal realm between molecules, could control the flows of heat and by extension, reverse time's entropic arrow. It was, in other words, a fantastical distillation of unfettered intentionality that became one of Victorian science's best arguments for free will.

3.5 Chaotic free will in Maxwell's demonic science

In an 1879 letter to Galton, Maxwell (rather facetiously) asks if he takes "any interest in Fixt Fate, Free Will &c."[83] Although it initially seems a throwaway remark, Maxwell is posing a serious philosophical challenge. The suggestive phrase "Fixt Fate" is quoted from Book II of *Paradise Lost* as the fallen angels lament their lack of free will; "Fixt Fate" and "Foreknowledge absolute" have preordained their rebellious actions (II. 560). But Milton also claims this vain philosophy finds "no end, in wandring mazes lost": it is little more than idle speculation; determinism is not inevitable (II. 561). The poetic analogy Maxwell draws between Galton's biological determinism and the devil's errant philosophy is clear: at a philosophical level, he argues, free will is never fully removed. There is always a capacity for choice in the face of external forces. For Milton, the fall damages human nature but it fundamentally does not affect free will. Nor is it preordained by God but rather the result of a multitude of singular and chaotic events. The fall, in fact, is the ultimate expression of wilful, intentional beings intervening in the world.

Against fixt fate, Maxwell also conceives of free will as being predicated non-deterministically: a point that he later makes to Galton in his letter. Before we get to that point, however, it is necessary to trace the two combined fronts on which Maxwell's challenge rests: a challenge that inverts Galton's own arguments against him. First, Maxwell shows that statistical methodologies imply a radical non-determinism at

[83] Maxwell letter to Francis Galton, 26 Feb. 1879. *The Scientific Letters and Papers of James Clerk Maxwell: 1874-1879*, ed. P. M. Harman, 3 vols (Cambridge: Cambridge University Press, 2002), III, p. 756.

the ontological level. And second, he shows the notion of entropy as a measure of information has ambivalent value: noise can damage a system; but it can also produce increasingly ordered information negentropically. From the implications posed by his famous paradoxical thought experiment, commonly known as ‘Maxwell’s demon’, Maxwell was able to ‘pick a hole’ in the second law of thermodynamics. He suggested that it was a probabilistic statement rather than an absolute law, and by doing so, inadvertently undermined the notion that purely deterministic forces governed matter and mind. Indeed, this position was further strengthened by Maxwell’s description of turbulent systems in which “an infinitely small variation in the present state may bring about a finite difference in the state of the system in a finite time”.[84] Contemporary chaos theory terms this phenomenon ‘sensitive dependence on initial conditions’. It was what Edward Lorenz discovered when small changes to the initial parameters of his computerised weather system set it off on a totally unexpected path. Both of these ideas—that thermodynamic laws might not be absolute, and that tiny bifurcations may yield proportionally greater systemic changes—grew out of a series of mathematical and observational experiments. But, as this final section argues, they are also theories whose finer imaginative points are grounded in Milton’s depiction in *Paradise Lost* of chaos as a vast realm, fizzing with turbulent energy. It is fitting then, that Maxwell’s anti-entropic notion of free will developed in the far away regions of outer space.

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30thJuly, 1610. Galileo had just dispatched a letter to the Grand Duke of Tuscany that bristled with excitement. “[T]he star of Saturn is not a single star,” Galileo wrote, “but is a composite of three”; they “are arranged in a row along the zodiac … and they are situated in this form ᵒOᵒ ….”[85] Galileo’s telescope had presented to him an image of Saturn comprised of three separate orbs. Fifty years later, Christiaan Huygens refined this startling observation, showing that Saturn owed its triple-bodied appearance to a

[84] Maxwell, *JCM*, p. 440.
[85] Galileo Galilei, letter to Belisario Vinta, 30 July 1610. Albert Van Helden, ‘Saturn and His Anses’, *Journal for the History of Astronomy*, 5 (1974), 105-21 (p. 105).

gigantic ring encircling the planet's primary mass. In the intervening years since Huygens's observation, little progress had been made in the way of explaining Saturn's gigantic ring. With the aid of more powerful telescopes, all that had been ascertained with any certainty was that the ring was in fact a set of *rings*. These magnificent celestial objects, "the most remarkable bodies in the heavens", continued to confound nineteenth-century scientists.[86] Were the discs solid or liquid? What were they made of? Why did they not break apart? In 1855, the University of Cambridge announced that the next Adams Prize, an award conferred by the University of Cambridge for exceptional research in mathematical science, would be bestowed to the entrant who could best answer these questions.

Maxwell set to work on the problem and in December 1856 submitted his findings; he was awarded the prize soon after. In his paper, Maxwell applied different branches of mathematics in daring analogical combinations and concluded that the rings must be "composed of an indefinite number of unconnected particles, revolving round the planet with different velocities according to their respective distances."[87] This was an astounding claim; over a hundred years later, the Voyager spacecraft would confirm its fundamental propositions to be correct. Equally significant was Maxwell's methodology. Although he was able macroscopically to model the rings' structure, Maxwell realised that in dealing "with collisions among bodies of unknown number, size, and shape, we can no longer trace the mathematical laws of their motion with any distinctness."[88] In other words, while it was impossible to calculate the dynamical trajectories of individual particles it was possible to model them as an average.

This insight represented a statistical turn in Maxwell's research and was further developed in his work on the kinetic theory of gases. In 1858, Maxwell read a paper by Clausius that argued gases are comprised of countless molecules moving around at immense speeds and constantly colliding into one another. This kinetic theory could

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[86] Maxwell, 'On the Stability of the Motion of Saturn's Rings (London: Macmillan and Co., 1859), p. 1.
[87] Maxwell, 'Saturn', p. 67.
[88] Ibid., p. 53.

account for a vast range of observed gaseous phenomena. But, for the theory to explain pressure, Clausius had to assume "that all molecules at a given temperature had the same speed."[89] Maxwell reasoned this could not be the case. His intervention was to devise a statistical function to calculate the overall distribution of molecular velocities and present them as an average.[90] As he found when dealing with the particulate matter of Saturn's rings, a complete dynamical view of a gas's molecules was impossible. However, viewed *statistically*, the distribution of each molecule's speed conformed to a standard deviation curve and thus their collective behaviour could be modelled as a probabilistic function. This was a profound intellectual shift. It heralded the beginning of statistical mechanics, which broadened the scope of analysis from gases to practically any system made up of a great number of components and exhibiting qualities of randomness.[91]

Maxwell's paper also contained a radical statement about the relationship between mathematical laws and physical reality. It suggested that the second law of thermodynamics might not in fact be absolute; it is only highly likely. To help others grasp the details of this strange statistical problem, Maxwell did what he had been doing since his childhood: he built an imaginary model. First introduced in an 1867 letter to Tait, Maxwell's analogy allowed him "to pick a hole ... in the 2nd law".[92] Imagine "two vessels divided by a diaphragm and let them contain elastic molecules in a state of agitation." These two vessels contain an equal number of molecules but the overall temperature of each is different. Within this closed system exists "a finite being who knows the paths and velocities of all the molecules by simple inspection but who can do no work except open and close a hole in the diaphragm."[93] This is where Maxwell's notion of thermodynamic law as merely a statistical observation comes into play. Although both sets of molecules have an average overall temperature, certain individual

[89] Raymond Flood, 'Introduction' in *JCM: Perspectives*, pp. 3-17 (p. 12).
[90] Later published in the *Philosophical Magazine* January and July, 1860.
[91] Gold, *ThermoPoetics*, p. 102.
[92] Maxwell letter to Tait, 11 December 1867, in C. G. Knott, *Life and Scientific Work of Peter Guthrie Tait* (Cambridge: Cambridge University Press, 1911), pp. 213-14 (p. 213).
[93] Ibid., p. 214.

molecules will be moving at a far greater or far slower speed than this middle point. When the being observes a single molecule in chamber A moving at a slower velocity than the average distribution of molecules in chamber B, it opens the hole and lets it through. The same action is made for chamber B molecules moving at a greater speed than the average of chamber A, into which they are allowed to pass. The number of molecules in each chamber remains the same. But eventually, "the energy in *A* is increased and that in *B* is diminished".[94] Heat, in other words has flowed from cold to hot, causing a net *decrease* in entropy and thus fundamentally violating the second law.

The lesson imparted by Maxwell's 'demon' (a term later coined by Thomson) is that scientific laws are only statistical probabilities. They map what is most likely but they are nonetheless phenomenological constructs unable to account for dynamic singularities. Thus, "the 2nd law of Thermodynamics", Maxwell wrote in a letter to the physicist John Strutt, "has the same degree of truth as the statement that if you throw a tumblerful of water into the sea you cannot get the same tumblerful of water out again."[95]

Whereas Galton's statistical method affirmed determinism, Maxwell's restores instability at the dynamical scale. The actual chance of a second law violation is almost infinitesimally small. Yet, as Hayles notes, "this tiny margin of improbability keeps the second law from having the force of absolute truth"; in light of Maxwell's statistical insights, "strict determinism" yields to "probabilistic prediction".[96] Maxwell was thus able to make an epistemological claim about the instability of scientific laws. They are theories that probabilistically map observed phenomena and make testable predictions about likely future events. They can describe with incredible analytic power complex processes, and translate them into mathematical notation. But, there are also

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94 Ibid.

95 Maxwell, letter to John Strutt, 6 December 1870, Harman, *Letters and Papers*, II, pp. 582-83 (p. 582).

96 N. Katherine Hayles, *Chaos Bound: Orderly Disorder in Contemporary Literature and Science* (London: Cornell University Press, 1990), p. 40.

phenomenological constructs, never able fully to close the gap between material reality and perception.

This suggestion is in fact remarkably similar to the point Maxwell made in 'A Vision'. Divorced from a "symbolising sense of sight", Pedantry's whirring instruments and arrowy forces offer only a partial glimpse of reality. In spite of her abundance of data, she is unable to transform raw information into meaningful knowledge. She is unable, in other words, to put information to *work*. The demon, however, does just this. It not only collects data, it *interprets it*, by considering the trajectory and speed of an individual molecule *in respect to the system as a whole*. Depending on its deviation from the average, the demon works out into which chamber the particle should be sorted to increase the system's usable energy.

Maxwell had thus more than simply picked a hole in the second law. He also connected entropy and information in a way no one else previously had. On one hand, his analogy suggested that the reversal of entropy was merely a problem of scale. The demon's faculties are "so sharpened that he can follow every molecule in its course" but they are also "still as essentially finite as our own".[97] If humans could devise a way of gathering information about the trajectory of individual particles, we too might "be able to do what is at present impossible to us" and create reversible engines.[98] On the other hand, Maxwell's demon suggested that entropic information could be viewed ambivalently. As the previous section argued, Barry and Galton both saw entropic information in purely negative terms. In Maxwell's heuristic, however, the demon transforms a disordered system into an ordered one using nothing more than information gathered about random particle motions.[99] 'Noisy' information, in other words, could have a positive value.

Without Maxwell's work on Saturn's rings and the constitution of gases, it seems unlikely the demon would have emerged as such a powerful thought experiment.

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97 Maxwell, *Theory of Heat* (London: Longmans, Green, and Co., 1902), p. 338.
98 Ibid.
99 In 1929, Leo Szilard showed that the act of gathering this information would itself increase the system's overall entropy, proportional to the useable energy created.

But the demon also owes its existence as an imaginative construct to a number of fictional influences. Its function as a gatekeeper positioned at a liminal threshold between two states, for example, has its poetic equivalent in Milton's Sin and Death. They too are agents within a closed system, who, upon opening the gates of hell that appear "like a furnace-mouth / Cast forth redounding smoke and ruddy flame", expose the Earth to a form of infernal heat flow (II. 888-9). In fact, Sin herself embodies a demonic thermodynamics by functioning as a reversible engine: hourly she births hell hounds that feed on her re-growing innards.

In the imaginative struggle for control over microscopic space, meanwhile, Maxwell's demon is pitted against Tyndall's atomic architect. Both beings embody negentropic tendencies, directing particles of matter to form new arrangements. But whereas Tyndall's architect served as an analogy for a constructive vital force, Maxwell's demon negates entropy by separating and dividing. It does not exert any actual force on molecules: it merely allows them to follow a highly improbable path. In fact, in this notion of a directive, rather than forceful agent, the demon finds its prototypical expression in an analogy Maxwell used to demonstrate how the will might exert a directive influence on the body: the pointsman. The railway pointsman shifted tracks and changed signals to direct the journey of trains. Likewise, Maxwell proposed, there "is action and reaction between body and soul" as "when a pointsman shunts a train it is the rails that bear the thrust."[100] Matthew Stanley argues that the pointsman would later evolve into the fictional scientific analogy of the demon "to solve not just religious difficulties but scientific ones as well."[101] The demon, a more advanced version of the pointsman, does indeed deal primarily with a scientific hypothesis. But it nonetheless furnishes the pointsman analogy with added argumentative clout by making a credible scientific claim about a metaphysical point. While the pointsman merely suggested that the will might have a directive power that was not in itself

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[100] Maxwell letter to Lewis Campbell, April 21 1862, in *Sci Papers*, I, 711-12.

[101] Matthew Stanley, 'The Pointsman: Maxwell's Demon, Victorian Free Will, and the Boundaries of Science', *Journal of the History of Ideas*, 69 (2008), 467-81 (p. 469).

material—if it did, as Maxwell wrote to Lewis Campbell, "the soul … would only last till it had done a certain amount of work" and eventually "run down"—the demon suggests *how* such an operation might be possible. Indeed, as Maxwell suggests in his letter to Galton, "[i]n most of the former methods … there was a certain small but finite amount of travail decrochant or trigger-work for the Will to do." However, in light of the implications posed by the demon, and research by other nineteenth-century physicists into the behaviour of non-linear systems, this "trigger-work" has all but been reduced to "mathematical zero".[102]

Contemporary chaos theory shows that in systems far from equilibrium, random fluctuations may bring about what is known as a point of bifurcation—essentially the moment of change effected by what Maxwell refers to as the trigger-work. At these differential thresholds the behaviour of a system becomes unpredictable: it might collapse in on itself or fork off on a new path and spontaneously organise into a more complex structure. In both cases, tiny changes spread rapidly throughout the system in a cascading series of increasingly powerful diversifications. If the system does self-organise into a structure of greater complexity, it has, on a *local* scale, become less entropic. Such sub-pockets of negentropy are entirely in accordance with the laws of thermodynamics as the tendency of the *overall closed system* will still ultimately be toward disorder. Maxwell's recognition that noisy systems had emergent potential lead Brian Hunt and James Yorke to claim in a 1993 article that "Maxwell was the first person to understand chaos".[103] According to the authors, Maxwell's investigations into dynamical systems led him to consider two of the most important concepts of modern chaos theory. First, that chaos is the natural state of things: non-organic structures, irregular patterns and organic life forms emerge spontaneously in systems of high entropy. Second, *sensitive dependence upon initial conditions*: the

[102] Maxwell, Letter to Galton, *Letters and Papers*, III, p. 756.
[103] Brian R. Hunt and James A. Yorke, 'Maxwell on Chaos', *Nonlinear Science Today*, 3 (1993), 2-4 (p. 2).

notion that a tiny fluctuation can produce an unexpected and correspondingly greater change in the overall state.

But while it is true that Maxwell's understanding of chaos was far more advanced than the majority of his contemporaries, Hunt and Yorke's claim is problematic. Maxwell's chaotic insights evolved not simply from his scientific work, but also from the work of philosophers and poets who had previously figured chaos as a heterogeneous state of productive turbulence. Michel Serres argues that chaotic ontologies are neither a twentieth nor nineteenth-century invention. In fact, he recognises the poetic anticipation of chaos theory in Lucretius' *De Rerum Natura*. According to Serres, the clinamen, Lucretius' theory of atomic swerve, describes pockets of turbulence that deviate from equilibrium, "troubling the flow of the identical".[104] These flows create "stochastic phenomena" that bring about the morphogenetic "formation of living systems", interrupting "the reign of the same".[105] Chaos, for Lucretius, was thus responsible for the immense complexity of matter and its myriad multiplicities. Maxwell was well acquainted with the clinamen having argued in 1873 that "our free will … is like that of Lucretius's atoms, which at quite uncertain times and places deviate in an uncertain manner from their course."[106] But Lucretius is simply one influence among many, including Milton. While Hunt and Yorke are thus justified in claiming Maxwell's scientific understanding of chaos was incredibly advanced for its time, they are wrong to claim that these insights had not been expressed in other ways before Maxwell.

In his letter to Galton, Maxwell channels these ideas about chaotic systems through recent research conducted by Joseph Boussinesq. Boussinesq had shown that differential equations describing the behaviour of fluid flow could, at certain singular points, have multiple solutions. This constituted a specific example of sensitive

[104] Serres, *Hermes*, p. 100.
[105] Ibid., pp. 103; 100.
[106] Ibid., p. 441.

dependence on initial conditions: singular moments that can disproportionately affect the outcome of a system:

> There are certain cases in which a material system, when it comes to a phase in which the particular path which it is describing coincides with the envelope of all such paths may either continue in the particular path or take to the envelope … and which course it takes is not determined by the forces of the system … but when the bifurcation of path occurs, the system, ipso facto, invokes some determining principle which is extra physical (but not extra natural) to determine which of the two paths it is to follow. When it is on the enveloping path it may at any instant, at its own sweet will, without exerting any force or spending any energy, go off along that one of the particular paths which happens to coincide with the actual condition of the system at that instant. In most of the former methods … there was a certain small but finite amount of travail decrochant or trigger-work for the Will to do. Boussinesq has managed to reduce this to mathematical zero.[107]

Note here how Maxwell draws an analogical link between Boussinesq's equations and the operation of the demon and pointsman. The small amount of "trigger-work" needed to change the state of the system has been reduced to a zero; like a train switching tracks, the system's behaviour bifurcates at a critical juncture to follow a new course. Indeed, the wider analogical construct at work here—a construct opposed to Galton's errant philosophy of 'fixt fate'—is the comparison drawn between non-linear systems and the human soul. In the material world, systems exhibiting degrees of aperiodicity may change at these points of bifurcation but do so "without exerting any force or expending any energy." They change, that is, immanently, without being pushed by an external agent. Likewise, the will, although having no material basis, can nonetheless bring about a material change in the body at a point of differentiation. Human behaviour is hence inherently non-deterministic; as Maxwell claimed in a lecture on science and free will: "in our own nature there are more singular points, where prediction, except from absolutely perfect data, and guided by the omniscience of contingency, becomes, impossible."[108]

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[107] Maxwell, Letter to Galton, *Letters and Papers*, III, p. 756.
[108] Maxwell, *JCM*, p. 444.

While Maxwell's refutation of Galton's determinism thus rests on the analogy between the will and points of bifurcation in physical systems, it is also given imaginative weight by his reference to Milton's chaotic cosmos. This highly entropic realm dispenses with Newtonian regularity in its rejection of extensive properties such as height or width, in favour of intensive properties of pressure, heat and turbulence. A "dark / Illimitable Ocean without bound, / Without dimension, where length, bredth, and height, / And time and place are lost", chaos is a region of "Eternal Anarchie" full of "noise" and "confusion" (II. 891-97). Moreover, Milton's "wild Abyss" where "Chance governs all" is imbued with morphogenetic potential. It is "The Womb of nature" whose "pregnant causes mixt" constitute the raw, "dark materials" for both creation and destruction (II. 910; 911; 913; 916). Milton's chaos thus paradoxically encompasses all aspects of moral classification, while at the same time encompassing none. Like Maxwell's demon, it too has ambivalent value: an ontologically indeterminate space whose complex irregularities offer the potential for emergent order and from which intricate moral, material and metaphysical systems owe their immanent flux. Mary Norton puts it thus: "The poem shows how order evolves out of Chaos, and simultaneously how order generates its own chaos. Chaos is the deep structure of creation, and Milton's Chaos is not only the universe's material origin, but also creation's ontological prototype."[109]

In a prototypical sense, Milton thus understood that that chaotic noise at an ontological level constitutes a mass of material 'information' from which surprising conditions could arise. But Milton also embeds the textual matter of *Paradise Lost* with indeterminacy. Peter Herman has argued that Milton's use of the word "or", often situated as a connective between elements in his extended similes, is used more than to conflate difference. Milton "also uses 'or' to provide a choice between different items

[109] Mary F. Norton, '"The Rising World of Waters Dark and Deep": Chaos Theory and *Paradise Lost*' in *Arenas of Conflict: Milton and the Unfettered Mind*, eds. Kristin Pruitt McColgan and Charles W. Durham (London: Associated University Press, 1997), pp. 129-39 (p. 129).

but without indicating a preference between them."[110] The Miltonic 'or' functions in the text as a poetic differential operator. It constitutes "the undoing of 'all' since unresolved choice implicitly deconstructs the imposition of unity called for by 'all'"; consequently, "Milton's consistent presentation of choices between opposite or differing possibilities results in an erosion, not a confirmation, of certainty."[111] In other words, Milton builds the concept of free will into the very fabric of *Paradise Lost* by allowing meaning-value to be determined outside of his authorial intent. The narrative's path hits critical junctures at which it can bifurcate to follow divergent analogical, poetic and allegorical paths.

We have already seen Maxwell use poetic differential operators in 'A Vision'. The poetic analogy he draws between Sin and Pedantry generates an excess of information that does not follow a single, authoritative route. Rather, the reader is enveloped in the poem as its mass of mythological, contextual and literary information only coheres with what Pedantry herself lacks: a 'symbolising sense of sight'—an ability, like the Demon, to transform raw data into measurable work. Pedantry, as a disparate collection of theories and analytical inputs, is a closed system, unable to produce coherent meaning on her own. By advocating for a connective, analogical approach to enquiry, the poem itself becomes an open system, able to cross communicate across domains while making a powerful statement about the limitations of epistemological certainties. It is a profound idea Maxwell also works in to his scientific analogies: set up a correspondence between a fictional and real state and allow the interior components to generate new outputs that can be fed back into the real system. Maxwell describes the value of this non-sensical methodology in his poem 'Molecular Evolution'. It suggests that ideas combined differentially, outside the normal bounds of the sensible, and freed from phenomenological constraints by way of textual bifurcations similar to the Miltonic 'or', deconstruct certainties: "What combinations of ideas / Nonsense

[110] Peter C. Herman, 'Paradise Lost, the Miltonic "Or," and the Poetics of Incertitude,' *Studies in English Literature 1500-1900*, 43, (2003), 181-211 (p. 183).
[111] Ibid., p. 185; 193.

alone can wisely form! ... those who Nonsense now are scorning, / May learn ... where wisdom lies."[112]

Moreover, in a review of Tait's *Thermodynamics* published in *Nature*, Maxwell explicitly uses the Miltonic 'or'. Describing the dual nature of scientific enquiry as both a battle against chaos and as emergence *from* it, Maxwell writes of Rankine's formative work on thermodynamics: "[i]n his earlier papers ... he appears as if battling with chaos, as he swims, or sinks, or wades, or creeps, or flies, 'And through the palpable obscure finds out / His uncouth way'".[113] Here, the Miltonic 'or' (combined with language recalling Satan's flight through chaos) represents the early confusion encountered by those who attempted to consolidate the laws of thermodynamics; a vast region of indeterminacy surrounds the scientific explorer with no clear route out of the "obscure". But the connective 'or' simultaneously represents the explorative act of scientific investigation, with a multiplicity of routes available to pursue. From this noisy environment emerges new knowledge; indeed, as Maxwell adds, Rankine "soon begins to pave" his way out of the "dark abyss".[114]

In these instances, Maxwell relies on the philosophical and imaginative implications of *Paradise Lost*'s depiction of chaos and its textual embodiment of incertitude and choice. Maxwell's letter to Galton embodies a combination of all three domains: Milton's poetry, recent scientific insights, and analogical combinations across domains: *the will functions like bifurcations in a turbulent system,* or *it is like the chaotic instability of Paradise Lost, opposed to the errant philosophy of 'fixt fate'*, or *it is like the action of a railway pointsman*, or *it is like the demon's ability to subvert entropic tendencies at a local, dynamical scale*. It is as if Maxwell challenges Galton to exercise his own intentionality—'choose whichever analogy makes the most sense for you; there are multiple options.'

[112] Maxwell, *JCM*, p. 638.
[113] Ibid., p. 663.
[114] Ibid.

In this way, the letter, and Maxwell's negentropic analogies throughout his work, function with a degree of stochastic autonomy. They do not, as Deleuze believes about representational thinking, constrain meaning to interior terms and misconstrue actual heterogeneity. Unlike the speculative analogies of Tait, Stewart and Tyndall, Maxwell's analogies, as *working models* embodying the chaotic divergences of the Miltonic 'or', are not bound to the authorial intent of its creator. They have a will of their own. Hayles makes a similar point in *Chaos Bound*. She argues that Maxwell's demon, as a conceptual operator, begins itself to function negentropically by undergoing stages of self-reflexive transformation. The demon's rich, non-sensical implications take on new meanings, penetrating multiple disciplines in a way Maxwell could never himself conceive. As she writes, the demon

> became a metaphor of itself, for in making equivocation an equivocal quality, the heuristic acknowledged that there was surplus meaning not only within the communication channel but within itself also. The constructive role that surplus meaning can play was then metaphorically incorporated into the order-out-of-chaos paradigm in the recognition that noise can sometimes cause a system to reorganize at a higher level of complexity.[115]

In its statement about the ultimate improbability of dynamical systems, Maxwell's demon hence embodied this very quality of emergent deviation. As an imaginative construct, its own "pregnant causes mixt" allow it to mutate and transform through a series of self-reflexive bifurcations. And as such, the demon inadvertently becomes an even more powerful analogy for the aleatory operations of consciousness and the will than Maxwell ever realised. Thought, Maxwell shows, is indeterminate.

Foreshadowing Shannon, Maxwell began to connect the measure of entropy in a thermodynamic system with the measure of information in a communications system. However, whereas Galton saw 'noisy' information in inherently negative terms, Maxwell saw that the potential for novelty to emerge from chaotic systems could challenge fixt fate. In the same way, Maxwell argued, the near infinite number of

[115] Hayles, *Chaos Bound*, p. 57.

opportunities for divergence in our own lives, freed the will from deterministic constraints. Moreover, Maxwell showed that Galton's statistical measure of genetic information did not confer deterministic tendencies to the local sub-pockets of a system's structure. Rather, against this trend, it in fact reinstated the possibility for the dynamic. Hence, against Clarke's suggestion that the demon was conceived to overcome entropy, Maxwell showed how entropy is both not a fatalistic certainty, *and* provides the necessary conditions for emergent thought and life.

Galton, with almost deterministic inevitability, rejected these implications. In his brief reply to Maxwell he wrote:

> I am rather busy just now with experiments on the workings of my own mind, and am almost frightened to find how distinctly cause & effect seem to govern everything. — If you happen to see the forthcoming "Nineteenth Century" (March) & care to look at a short paper in it by me "Psychometric facts" — it will as you will see describe something of what I mean.[116]

That particular essay, 'Psychometric Facts' actually adds little to Galton's reply in the letter. Rather, a more definite appraisal of his views on fixt fate can be found in an article published five years later in the *Fortnightly Review*. "[M]an is little more than conscious machine, the larger part of whose actions are predictable".[117] Consequently, Galton rejects the dynamical view of the will to conclude that, "the statistics of each man's conduct in small every-day affairs … will probably be found to give the simplest and most precise measure of his character."[118] Nevertheless, in the creation of the demon, and the connection of scientific and poetic descriptions of chaos, Maxwell had demonstrated that Galton's determinism, and Tait and Stewart's notion of continuity, were inherently flawed. In both the operations of the mind and the operations of matter, disorder reigns.

[116] Galton letter to Maxwell, 27 Feb. 1879. As printed in Theodore M. Porter, *The Rise of Statistical Thinking 1820-1900* (Princeton: Princeton University Press, 1986), p. 207.
[117] Francis Galton, 'Measurement of Character,' *Fortnightly Review*, 36 (1884), 179-85 (p. 181).
[118] Ibid., p. 185.

3.6 Conclusion: Maxwell's negentropic analogies

In Maxwell's take on thermodynamic law, analogies function as more than imaginative constructs describing the characteristics of dynamical systems. They instead work within and through literature and thought, operating at times nonsensically and out of stable phenomenological confines to create information negentropically.

In 'A Vision', Maxwell criticises reductive epistemologies that ignore metaphysical forms of knowledge. Even at this young age he was questioning the absolutism of scientific laws. While they might describe a phenomenon with great precision they were still subject to change, even degradation over time. Without a "symbolising sense of sight", their piles of data reduced the world to mere "arrowy forces". By drawing a comparison between his allegorical figure of Pedantry and Milton's Sin, Maxwell demonstrates that reductive epistemologies do not transform information: rather, they only reproduce the same and even bring about the loss of true knowledge in their failure to make discrete components or ideas cohere. Maxwell built on this idea in his rejection of the analogy between nonhuman and human forms of memory and in his ontological challenge to Galton's determinism. Far from constraining free will, deterministic tendencies can be subverted by small deviations from the norm: points of bifurcation that arise spontaneously from noise. Thought, Maxwell argues, can be negentropic. It is not bound by 'fixt' material conditions but is capable of exerting a directive influence *on* material conditions, in the same way the demon channels individual molecules. And at both an epistemological and ontological level, thought retains a degree of indeterminacy that undermines any supposed principle of continuity existing between matter and mind.

Maxwell's analogical thinking and its entanglement with thermodynamic ideas is thus very different from that of Stewart, Tait and Tyndall. Their creation of pseudoscientific fantasies of conservation relied on tenuous analogies that were constructed from the top down. Stewart, Tait and Tyndall all began with a particular thermodynamic narrative and subsequently twisted scientific ideas to fit within it. But Maxwell's analogies break this mould. They in fact show that Deleuze's critique of analogy ignores the potential for conceptual constructs to perturb systems of meaning. Moreover, Deleuze fails to see that analogical thought can be a complex process that combines the material, the concrete and the imaginary. After setting the input values, Maxwell's poetic and scientific analogies operated semi-autonomously. Because he treated them like black boxes, Maxwell could not always predict the outputs they would produce—such as the incredibly apposite analogy between electrostatic force and fluid motion, which led to his famous electromagnetic equations. Ironically, it was from his work on statistics—which showed that a complete dynamical view of a system was impossible—that Maxwell inadvertently stumbled across a dynamical concept that undermined entropic inevitability.

Throughout this chapter, I have argued that Maxwell developed these ideas from *Paradise Lost*. Without its demons situated at the thresholds of thermodynamically distinct spaces (hell, chaos, the earth), its depiction of chaotic turbulence providing the ontological conditions for annihilation *and* creation, its unstable memories undermining the construction of teleological ur-narratives and its poetic differential operators, offering the chance for its readers to exercise their own free will by bifurcating down a divergent literary path, Maxwell's ideas would not have had the imaginative force they did. In fact, his insights about entropy, information and chaos often emerged unexpectedly from the combination of science and poetry.

For Maxwell, language and thought function intensively by creating new concepts from the differential disjunction between terms. Both poetic and scientific writing are themselves material systems, operating at times in the margins of sense and acting as engines of imaginative novelty. But the strange and dynamic interactions between matter, language, thought and time are not restricted to works written by scientists. In fact, non-scientific literature of the nineteenth century was also concerned with the implications posed by intensive matter. If, for example, consciousness and love are partially materially constituted, if they are partly the product of natural forces, does this negate their personal, human and numinous qualities? And is there a place for idealism in a material world constantly being remoulded by nonhuman morphogenetic energies? These are ideas Maxwell grappled with throughout his career. But they are also problems embodied in the poems of Robert Browning. It is not just scientists who dealt with material problems. As Maxwell writes, and as we will see in the following chapter, "Mr. Browning has written much better poems with half the quantity of poetry at his disposal."[119]

[119] Maxwell letter to C. H. Cay, 18 November 1863 in *JCM*, pp. 336-37 (p. 337).

CHAPTER FOUR

'The infinite passion of finite hearts': the paradoxes of disjunctive love in Robert Browning's 'Two in the Campagna'

Introduction: Browning's intensive poetry

The opening lines of Robert Browning's 'Life in a Love' published in *Men and Women* in 1855 paint a disturbing portrait of obsessive infatuation:

> Escape me?
> Never—
> Beloved!
> While I am I, and you are you,
> So long as the world contains us both,
> Me the loving and you the loth,
> While the one eludes, must the other pursue[1]

Browning had an uncanny ability to inhabit the minds of unstable, insecure and deranged individuals, particularly those driven mad with desire. This poem proposes some extremely unsettling ideas common to Browning's love poetry: that love is possessive; that once the worlds of two people have become imbricated there is no possibility for escape; that one lover's intransigence can overpower the other's reluctance; and that love can be, and often is, defined by unbalance: mental, bodily (as the speaker of the poem remarks, love "keep[s] the nerves at a strain"), and social.

The disturbing and paradoxical implications of intensive love are the subject of this chapter, specifically its figuration in Browning's 'Two in the Campagna' (1854). In

[1] Robert Browning, 'Life in a Love' in *Robert Browning, The Poems*, ed. John Pettigrew, 2 vols (London: Penguin, 1981), I, p. 604.

its embodiment of disjunction between ideal and material, infinite and finite, time and space, the poem wrestles with the paradox of poetic creation: by fixing in language that which is excessive and motile, the poet simultaneously inscribes the world anew yet exposes the non-relations between self and other.

Love, in Browning's works, is rarely figured as something which transcends material reality but rather as a powerful energy imbricated within it. Indeed, the speakers of his poems are often forced to confront desire's materiality: its emergence from the nervous and chemical interactions taking place in the body and its abundant promiscuity in the nonhuman organic world. As they do, ideal notions of pure desire, Romantic unity with the other and poetic creation come under threat as they are forced to participate in love's perpetual renewal. One of the central tensions of Browning's poetic thought is the recognition that the material world in all its grotesque vibrancy—bodies, stuff, minds and language—is the prepotent foam from which the ideal evolves. As the eponymous 'Fra Lippo Lippi' (1855) suggests, the realist artist has to look at the world through "intense eyes": "Make his flesh liker" and the "soul more like" will follow.[2]

Yet Browning's precise views on materiality are difficult to pin down. So too are his religious convictions. As Elizabeth Barrett Browning cautioned a friend who believed that the double poem 'Christmas-Eve and Easter-Day' (1850) was a clear expression of Browning's faith: "Certainly the poem does not represent his own permanent state of mind, which was what I meant when I told you it was dramatic."[3] The one consistent view that emerges from his texts is a disavowal of extremism, whether it is the crass materialism of Bishop Blougram, the asceticism of the monastic scholars in 'Fra Lippo Lippi', or the overly idealistic Sordello. In spite of these uncertainties, nineteenth-century critics often cast Browning in the role of religious

[2] Robert Browning, 'Fra Lippo Lippi' in *Browning: The Poems*, I, pp. 540-50 (p. 545; 544; 545).
[3] As quoted in *The Poetical Works of Robert Browning*, eds., Ian Jack, Rowena Fowler and Margaret Smith, 8 vols (Oxford: Clarendon Press, 1991), IV, p. 320.

teacher and as a poet who shunned the material world in favour of transcendent idealism. Writing in 1898, for example, James Fotheringham claims:

> No man holds more deeply, and no poet has given more forcible expression to a conviction of the higher issues of life—to the belief in the reality of a life and order more perfect and more beautiful than the actual world.[4]

For Fotheringham, Browning describes the grotesquery of "the actual world" only so that he may point to an ideal order of perfection that might be attainable in spite of it. Arthur Pigou makes a similar claim in his evaluation of *Robert Browning as a Religious Teacher* (1901): "[s]cattered throughout [Browning's] works there is … much that the idealist school, with which he had allied himself, could enthusiastically welcome and praise."[5] In fact, Pigou continues, Browning's philosophy constitutes an "emphatic rejection of materialism in the language of poetry".[6]

It was this supposed effort to attain a transcendent ideal that, for many of Browning's readers, was the driving force behind his poetic thought. It was also what contributed to its apparent obscurity, even failure. After praising their "remarkable … range and their intensity,"[7] the writer of Browning's obituary in *The Athenaeum* goes on to criticise his poems' formal deficiencies:

> He was faulty in form almost always—faultless scarcely ever. Often, indeed, his choice of metre struck a false note from the start; … [his] lapses … point to some inherent defect in the poet's method. … He attempted the impossible task of setting forth in verse the totality of impressions, emotion, aesthetic, and intellectual, which his object made upon him. … [H]is sentences become congested with suggestion. Hence their stimulating effect, but it is not a poetical one.[8]

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[4] James Fotheringham, *Studies of the Mind and Art of Robert Browning* (London: Horace Marshall & Son, 1898), p. 85.
[5] Arthur Cecil Pigou, *Robert Browning as a Religious Teacher* (London: C. J. Clay and Sons, 1901), p. 126.
[6] Ibid.
[7] Anon, 'Obituary—Mr. Robert Browning', *The Athenaeum*, 3243 (1889), 858-60 (p. 860)
[8] Ibid., p. 869.

In this assessment of Browning's style is in fact an indication of what makes it intensive: the discordant metre which does not harmonise with its content but instead, strikes a "false note"; the attempt to draw out the "totality of impressions" from an experience and squeeze them back into language; the impact "object[s] made upon him", not a projection of qualities onto objects; sentences "congested" with rhetorical matter; and crucially, the physiologically "stimulating" but "not poetical" effect of his language.

Other Victorian critics also noticed the "stimulating" quality of Browning's work. "There is hardly any English poet", wrote a commenter in *The Spectator*, "who has a greater power of delivering an electric shock than Mr. Browning".[9] His "verse ... flashes—as a galvanic battery" and the "vigorous jolts which [it] administers to the imagination" also "makes the nerves tingle and the eyes involuntarily close".[10] These are curious qualities to observe in a poet who 'emphatically rejected materialism.' If anything, matter and affect seem inherent to Browning's poetry.

Like the confusion over Tyndall's Address, the conflicted responses to Browning's work are telling. Modern critics have claimed that they derive from the fundamental tensions embodied in his poetry. For Gregory Tate, "the division between mind and body, thought and act" is one of Browning's central concerns.[11] His poetry deals not with "complete and indissoluble concepts," but rather, the "fragmented reality of artistic practice and spoken rhetoric."[12] This chapter is similarly concerned with the divisive material conflicts of Browning's poetry. Modern critical analyses of materiality in Browning have tended to focus almost exclusively on two aspects: the literalisation of mental processes conveyed via dramatic speech and act; and the profusion of objects, fleshly bodies and foreign curiosities. But Browning was also, this chapter argues, a pioneering intensive materialist. His poetry concretises what is already tangible but

[9] 'Anon, 'Robert Browning', *The Spectator*, 63 (1889), 838-39 (p. 838).
[10] Ibid.
[11] Gregory Tate, *The Poet's Mind: The Psychology of Victorian Poetry 1830-1870* (Oxford: Oxford University Press, 2012), pp. 170-71
[12] Ibid.

gestures towards the thresholds at which matter and spirit, extensive and intensive converge. These points of transformation are embedded in his poetry's syntax and structure and though his verse fleetingly delves into the material and spiritual, it never settles on either side of this divide. Indeed, these two realms are not stable and separate but only emerge, for Browning, in the moment a spark passes between them. Moreover, this chapter claims, in exploring the horrifying multiplicity of organic evolution years before the publication of *Origin*, Browning both anticipated, and participated in the creation of, the onset of a new evolutionary worldview.

In *Hermes*, Michel Serres makes similar claims about J. M. W. Turner. If Serres overstates the case in claiming that Turner was "[t]he first true genius in thermodynamics" he nonetheless is right to argue that the painter "is not a pre-impressionist" but a "realist, a proper realist."[13] Turner "makes one see matter" in a way "[n]o one had really perceived it before": he "makes it vibrate, tremble, oscillate," at the point "where edges collapse."[14] Browning's poetics of process similarly renders matter and soul in a way no one had really done so before. He was, as one reviewer correctly noted, "the founder … of a new school, a realistic school".[15] He used words like Turner used paint. With a vocabulary of around 40,000 words, "double that of Tennyson or of Shakespeare", Browning revelled in the plasticity of language.[16] From the combination of colloquial and formal expressions, speech and act, language could reveal and create "Power and Love in the absolute, and … Beauty and Good in the concrete".[17] And yet, for all his prodigious literary skill, Browning was never in total control over language. Indeed, his works poeticise "his struggle to subdue language to his will" and the sense that "[t]he world and life's too big" to fit into neat artistic spaces.[18]

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[13] Serres, *Hermes*, p. 57.
[14] Ibid., p. 58.
[15] Anon, 'Robert Browning's Latest Poem', *The St. James's Magazine*, 8 (1871), 83-91 (p. 84).
[16] John Pettigrew, 'Preface' to *The Poems*, I, p. xx.
[17] Robert Browning, *Essay on Shelley: being his introduction to the spurious Shelley letters*, ed., Richard Garnett (London: Alexander Moring, 1903), p. 51; 71.
[18] Browning, 'Fra Lippo', p. 546.

In the same way Maxwell believed matter's indeterminacy could only be glimpsed with a symbolising sense of sight, so too did Browning claim that any notion of the ideal derived from the material world's "beauty … wonder and the power, / The shapes of things, their colours, lights and shades, / Changes, surprises".[19] As Browning writes in his *Essay on Shelley* (1851): "[t]he spiritual comprehension may be infinitely subtilised … [but] the raw material it operates upon, must remain."[20]

'Two in the Campagna' represents one of the most striking examples of this intensive style. What makes it all the more noteworthy is its apparently simple structure, uncomplicated vocabulary and regular meter and rhyme. However, Browning uses a straightforward poetic frame to explore the interweaving of opposition and harmony, matter and spirit, the singular and the multiple as the speaker of the poem struggles with the paradoxes of disjunctive love. Hence, the poem is radical in two ways. First, it deconstructs the idea of love as an ideal form, instead presenting it as a complex multiplicity comprised of interwoven strands located in time, space and matter. And second, it draws attention to its own constructed artifice to complicate its status as a 'love poem'. The chapter analyses these ideas by considering them from three interrelated aspects of 'Two in the Campagna' and comparing them to similar concerns in Browning's middle-period works. First, the dichotomy between the finite and the infinite and the poem's attempts to "count" love numerically; second, how its representation of organic nonhuman desire results in the temporary annihilation of the speaker's selfhood; and third, the frustrating inability to grasp the intangible remnants of intensive love, no longer actualised in the material world.

[19] Ibid., p. 547.
[20] Browning, 'Shelley', p. 42.

4.1 Multiplicities and disjunctive love

Two further theoretical ideas frame my reading of Browning's intensive desire. First the concept of quantitative and qualitative multiplicities developed by French philosopher Henri Bergson; and second, Deleuze's notion of disjunctive love. Multiplicities for Bergson are not multiple, as defined by opposition to the one. Instead, developing Bernhard Riemann's mathematical manifold—a non-Euclidean space of n-dimensions—Bergson suggests there exist two types of multiplicity: spatial and temporal. "[T]he difficulty that we have in conceiving [time]," writes Bergson,

> comes simply from the fact that we extend to [it] … that obligation of *containing* and *being contained* which applies only to the collection of bodies instantaneously perceived in space. The fundamental illusion consists in transferring to duration itself, in its continuous flow, the form of the instantaneous sections which we make in it [emphasis original].[21]

Time, Bergson says, is an indivisible process of transformation which cannot be broken into discrete units: to attempt to do so is to confuse duration with spatial extension.

To help his readers grasp this tricky distinction, Bergson uses two analogies to contrast quantitative multiplicities (space) with qualitative multiplicities (duration). Quantitative multiplicities can be thought of like a flock of sheep. Generally, all the sheep look alike but we are still able to count them individually. To do this, we see the sheep as spatially separated, each occupying a particular location. When we imagine a certain number of sheep in our minds (say five), we tend to imagine five sheep arranged next to one another, rather than a single sheep representing the whole amount. "[I]n order that the number should go on increasing," says Bergson, "we must retain the successive images and set them alongside each of the new units".[22] What we have imagined is spatial homogeneity rather than temporal heterogeneity. It is what

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[21] Henri Bergson, *Matter and Memory*, trans. Nancy Margaret Paul and W. Scott Palmer, (London: George Allen Unwin, 1919), p. 193.
[22] Henri Bergson, *Time and Free Will: An Essay on the Immediate Data of Consciousness*, trans. F. L. Pogson (New York: Cosimo, 2008), p. 77.

Bergson means when he says that the “illusion” in conceiving time is to think of it in terms of “instantaneous sections.”

Qualitative multiplicities meanwhile, are continuous and heterogeneous. Bergson explains this difference by tracing the development of sympathetic feelings. After moving through various emotional states, the “increasing intensity of pity” produces a “qualitative progress” whereby the transition is made “from repugnance to fear, from fear to sympathy, and from sympathy itself to humility”.[23] These emotional responses meld together without opposition or separation. They evolve continuously and are interwoven with one another, so that no distinct feeling is prioritised. Bergson suggests that real duration, intensive and lived, is similarly indivisible. This distinction between quantitative and qualitative multiplicities frames my reading of ‘Two in the Campagna’. It too is concerned with the interaction between these two modes of time and space. Love, and its intensive evolution, is presented in the poem as something heterogeneous and uncontainable. And yet throughout, the speaker attempts to ground himself and his desire by measuring love and time incrementally.

The contrast between quantitative and qualitative multiplicities is also related to Deleuze’s notion of disjunctive synthesis, and the important role this has in creating love. “In Deleuze’s [and Guattari’s] technical vocabulary,” writes philosopher Levi Bryant, “a disjunctive synthesis is a synthesis of divergent series that do not converge yet somehow manage to communicate by virtue of a *difference* that passes between them like a spark [emphasis original].”[24] Because for Deleuze and Guattari, the univocity of ontological being is difference, the most primary relation between things is divergence. The most basic type of synthesis in Deleuze’s ontology is connective, and the one that makes the most intuitive sense: things are related to one another through a set of similarities. Disjunctive synthesis, however, does not relate things through identity but instead affirms the difference between terms. Bryant expands upon this

[23] Ibid., p. 19.
[24] Levi Bryant, ‘Love’, *Larval Subjects*, 2011, https://larvalsubjects.wordpress.com/2011/05/19/love/ [last accessed May 2015].

idea with the following example. “My cat and I share entirely different *worlds* even though we inhabit one and the same *earth* or heteroverse [emphasis original].” Yet, Bryant continues, “[s]omehow our worlds come to be imbricated and entangled with one another, even though they don’t converge on any sort of sameness.”[25]

Deleuze and Guattari’s notion of love thus contrasts relationships founded upon connective and disjunctive synthesis. As they write in *Anti Oedipus*, “[t]he persons to whom our loves are dedicated … intervene only as points of connection, of disjunction, of conjunction of flows.”[26] For Bryant, love founded upon “*conjunctive synthesis*, where the two lovers converge on identity … lacks the differential energy to perpetuate itself or continue itself [emphasis original].” On the other hand, disjunctive love is “to fall in love with a world that one cannot assimilate, consume, or domesticate. … In disjunctive love the lovers are withdrawn from one another as worlds, yet still somehow in relation.”[27] Of course, disjunctive love is both productive and destructive. In challenging the hegemonic arrangements of love, it also challenges the construction of self and other.

The speaker of Browning’s ‘Two in the Campagna’ wrestles with exactly this notion of disjunctive love. Although he feels the infinite power of love pass between himself and his beloved, he is unable to retain a hold on it. In realising that love is a temporal and material process, something which is collaboratively made but ultimately predicated on differentiation, he responds with ambivalence and at times, frantic horror. While he is able momentarily to touch this difference, love and his partner elude him. Though their worlds—shared memories, private thoughts, bodily connections—become imbricated and entangled, they never fully converge. In struggling to comprehended this disjunction, the speaker of the poem attempts to fix it

[25] Bryant, ‘Love.’
[26] Gilles Deleuze and Felix Guattari, *Anti Oedipus: Capitalism and Schizophrenia*, trans. Robert Hurley, Mark Seem and Helen R. Lane (Minneapolis: University of Minnesota Press, 1983), p. 293
[27] Bryant, ‘Love.’

within a quantitative framework. Yet the poem's form itself disrupts this attempt, its structured metrics and rhymes unable to contain love in excess.

4.2 "Putting the infinite in the finite"

The apparently simple structure and rhythm of 'Two in the Campagna' mask a deceptively complex design. Twelve stanzas of five lines each are adorned with the rhyme scheme ABABA, the first four lines in iambic tetrameter and the fifth in iambic trimeter. Time inheres in the poem's palimpsestual layering of past, present and future and its concern with counting the discontinuous flow of duration. The speaker ponders over the "lengths of hours" taken to produce such a variety of forms in the natural world while at the same time slipping "[o]ut of that minute". But time, or at least these regulated minutes and hours of divided time, are also built into the poem's structure. Twelve stanzas of five lines adding up to a total of sixty lines across the poem: or, in other words, the sixty minutes making up an hour. Printed on the page, each verse or five-minute block is separated by a roman numeral: from I through to XII. The visual impression of a clock face divided into hours and minutes combines with the iambic rhythm, which moves through the lines with the metronomic 'tick-tock' of passing seconds.

From the opening verse, the poem thus reveals itself to be concerned with measuring love as it moves through time and in quantifying the qualitative through counting:

> I wonder do you feel to-day
> As I have felt since, hand in hand,
> We sat down on the grass, to stray
> In spirit better through the land,
> This morn of Rome and May?

The first line introduces the two subjects of the poem: the “I” of the speaker and the “you” of the beloved. Throughout, the speaker wonders if his own tangential thought processes—“Like turns of thread the spiders throw”—are similar to those of his lover. Even though the poem is presented from the point of view of the primary speaker, it encompasses two subjectivities. But in being denied access to the beloved’s thoughts—thoughts which like his own, have “tantalized me many times”—the divided I and you are unable to form a unified whole.

In the first line of this stanza and throughout the poem, Browning embodies the doubled and divided aspect of love, the I and the you coupling, in the interplay of homonyms. “I *won*der … you feel *to*-” reads aloud as “I one … you … two”, with the iambic stress falling on the “one” of the speaking subject. In addition to enfolding the selfish and singular nature of love with the selfless and conjoined, the simple “one … two” homonyms set the poem in motion, its steady measure of time “[b]eating” like the speaker’s “heart”. The rhythms of the body—the ticking heart and the whirring of thought—are thus imbibed in the poem’s form. Yet the forward momentum of the line is broken by the hyphenated “to-day”, already indicating that the passage of the lovers through the poem will be interrupted. Furthermore, time is interwoven into a palimpsest of past and present. In asking “do you feel to-day / As I have felt since,” the speaker moves from the immediate present to the past (“have felt”), only to reverse again the temporal direction with the adverb “since”. Likewise, “we sat” juxtaposes a past event with the infinitive “to stray”—shifting temporal dimensions which are brought back in the final line of the stanza to the present: “This morn”.

Similar tensions between different temporal modes and tenses—qualitative multiplicities of pure duration—struggle with the speaker and Browning’s efforts to contain them in a quantitative framework. After the publication of *Men and Women*, John Ruskin wrote to Browning criticising the volume for its obscurity. In response, Browning tersely replied:

We don't read poetry by the same way, by the same law; it is too clear. I *know* that I don't make out my conception by my language, all poetry being a putting the infinite within the finite.[28]

One of the central tensions of Browning's poetry emerges from this problem of attempting to express the infinite range of emotions, sensations and encounters between people and things in finite language. How, for example, is time to be fixed spatially? How is thought to be rendered in language? How is it possible for the spirit to "stray" by sitting?

These are questions with which Browning's poetry continually wrestled. In *Fifine at the Fair* (1872), the latter-day Don Juan explains that the metaphysical task of the poet is to find and express the numinous immanent to the world: "His problem posed aright / Was—"From the given point evolve the infinite!"[29] In 'By the Fireside' (1848), the speaker contemplates the paradox of marriage, something which is defined both by a single ceremony and a passage through time: "Oh moment, one and infinite! / The water slips o'er stock and stone".[30] And in 'England in Italy' (1845) (the companion piece to 'Italy in England', one set of Browning's many experimental 'paired' poems), the speaker marvels at "those mountains, their infinite movement! / Still moving with you—".[31]

In these poems, encounters with boundlessness are, for Browning, synonymous with leading an ethically vibrant life. But they are also epistemologically shocking—an idea expressed in Browning's repeated use of exclamation marks after poetic expressions of the infinite. Indeed, putting the infinite in language is problematic; it is something that words cannot describe but must create anew. Thus, for Browning, poetry—itself an aspect of finite material reality—can gesture towards the infinite by embodying this tension. This is a point Browning makes in his *Essay on Shelley*, which

[28] Robert Browning, letter to John Ruskin, 10 December 1855, in John Ruskin, *The Works of John Ruskin*, eds. Edward Tyas Cook and Alexander Wedderburn, 39 vols (London: George Allen, 1909), XXXVI, p. xxiv.
[29] Robert Browning, *Fifine at the Fair* (London: Smith, Elder and Co., 1872), p. 165.
[30] Robert Browning, 'By the Fireside' in *The Poems*, I, pp. 552-61 (p. 558).
[31] Robert Browning, 'England in Italy' in *Robert Browning: Selected Poems*, eds. John Woolford, Daniel Karlin, Joseph Phelan (New York: Routledge, 2010), 254-64 (p. 269).

makes a distinction between 'subjective' and 'objective' poets. Shelly and other Romantic idealist poets are regarded as examples of the former school while Browning considers himself to be an example of the latter. The subjective poet "appeal[s] through himself to the absolute Divine mind" and prefers to subordinate "the noisy, complex yet imperfect exhibitions of nature" to "his inner light and power … the beating of his individual heart".[32] The objective poet, however, "endeavour[s] to reproduce things external (whether the phenomena of the scenic universe, or the manifested action of the human heart and brain) with an immediate reference".[33] Indeed, "[s]uch a poet is properly the ποιητης, the fashioner; and the thing fashioned, his poetry, will of necessity be *substantive* [emphasis mine]."[34]

Similarly, the power of literature, for Deleuze and Guattari, is precisely its ability to affect and shock readers by exposing the disjunctive relationship between the actual (the finite) and the intensive (infinite). As they write:

> What matters [in literature] is not … the opinions held by characters in accordance with their social type and characteristics but rather the relations of counterpoint into which they enter … [E]verything comes to end at infinity … From every finite thing, [the artist] makes a being of sensation that is constantly preserved, but by vanishing on a place of composition of Being: 'beings of flight.'[35]

By embodying disjunction (or moments of counterpoint) within its textual body, literature is able to make partially thinkable—but crucially, not totally comprehensible—the infinite. It creates a unique moment from the disjunctive synthesis of material world, text and reader. The Proustian madeleine is for Deleuze and Guattari, a perfect example of the creation of a fleeting moment of infinity differentiated from the non-relation of two divergent series. When Marcel tastes the cake and involuntary sensory memory is forced upon him, Combray appears "like it

[32] Browning, 'Shelly', p. 40.
[33] Ibid., pp. 33-34.
[34] Ibid., p. 35.
[35] Gilles Deleuze and Felix Guattari, *What is Philosophy*, trans. Hugh Tomlinson and Graham Burchell (New York: Columbia University Press, 1994), pp. 188-89.

never was, is, or will be lived."[36] But the paradox of this endeavour—that the infinite is overwritten in the very moment it is inscribed—is that it can only be expressed in a disjunctive relation which remains *unresolved*. In articulating the infinite, by fixing it in form, what makes the infinite *infinite* is lost. The infinite cannot be attained and held indefinitely but only grasped momentarily through a continual process of revaluation, inscription and change.

The failure to approach this dilemma with due subtlety is what brings about the eponymous *Sordello*'s (1840) ruin. Sordello becomes so fixated with the idea of an immobile and ideal version of the infinite, with "Thrusting in time eternity's concern", that his aggression rebounds upon him.[37] He is unable to disentangle the delicate ephemerality of real infinity from his crude characterisation of it and there is something grotesque in his attempts forcibly to "Compress the starriest into one star, / And grasp the whole at once!"[38] (Of course, anyone familiar with *Sordello* will recognise this as a failing of the poem too.) Sordello's fixation on the infinite is at the expense of the finite world. He lives life as an extremist on the outermost edge of knowledge and experience, unwilling to forge a dual existence balancing the finite and infinite. Indeed, in his hubristic attempt to gain omniscient and omnipotent power, Sordello is ultimately forced to contend with the finite limitations of his own subjectivity. The problem Browning's poetry exposes is thus not merely how to 'put the infinite in the finite.' It is also in understanding the point at which such an ambitious task becomes impossible: about finding an equitable balance between extremes, which, as Edward Dowden wrote in 1867, affirms "an endless series of aspirations, and endeavours, which generate new aspirations and new endeavours."[39]

The attempt and failure to find this balance is the central conundrum of 'Two in the Campagna'. This tension between ideal and real infinity, ideal and real finite, is

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[36] Ibid., p. 168;
[37] Robert Browning, *Sordello* (London: Edward Moxon, 1840), p. 25.
[38] Ibid., p. 37.
[39] Edward Dowden, 'Mr. Browning's *Sordello*' in *Robert Browning*, ed. Harold Bloom (New York: Bloom's Literary Criticism, 2009), 80-86 (p. 83).

expressed in the juxtaposition of the quantitative and the qualitative and the speaker's attempt to 'count', or statistically model dynamic love. As Deleuze and Guattari write in *Anti Oedipus*: "There is always something statistical in our loves, and something belonging to the laws of large numbers." The challenge facing the speaker of 'Two in Campagna' is that he desires paradoxically to express infinite love within the finite by using a quantitative framework. In attempting to do so, however, he is overwhelmed by the incalculability of desire, nature and the otherness of his partner, only narrowly avoiding Sordello's fate in a final moment of paradoxical understanding. Even small numbers and supposedly simple calculations—one plus one, you plus me—are fraught with complications. We have already seen that the homophonic play on "one … two" sets the poem in a rhythmic linear tick-tock motion that is instantly undermined by the intermingling of temporal states. But throughout the poem, love simultaneously transcends and is limited by the finite in the speaker's attempt to add up himself and his lover to make a unified whole. The title, for example, locates *two* in the Campagna. But as the poem progresses it becomes increasingly apparent that even locating *one* in the Campagna is practically impossible. Likewise in the ninth stanza the speaker yearns to make "your part my part" but instead encounters resistance in the structural shift to the following verse:

—your part my part
In life, for good and ill.

X
No.

The longing for a love forged from the combination of parts is doubly denied by the poem. The negative response "No" is furnished with added emotional weight through the caesura breaking the line in two and the roman numeral "X" hovering over the verse. Even though the speaker yearns to solidify his love, he is simultaneously repelled by his own attempts to constrain it systematically. Love, he feels is boundless yet ephemeral and can only be glimpsed paradoxically—by the failure to count up to it with finite numbers.

Echoing the Hamletian philosophical dilemma pondering the solace of nothingness over existence, the speaker wonders whether "To love or not to love?" Love offers completion. But in failing to find unification, the speaker wonders if a life without love provides a more grounded existence. Moreover, the poem's numerical homonyms imply that the line is also an expression of numerical limitation—of failing to count the uncountable. Thus, it also reads 'Two love or not two love?' A similar failure to add up one from two occurs in the third stanza, describing the meandering thread of the speaker's thought as it contemplates the immediate material surroundings of the Campagna:

> ... First it left
> The yellowing fennel, run to seed
> There, branching from the brickwork's cleft,
> Some old tomb's ruin: yonder weed
> Took up the floating weft

In contemplating the "cleft" of "Some old tomb's ruin," the speaker considers what it means to be a couple with a long history, casting himself and his beloved as 'Some old *two*'. The homonym between to/two also affords a further doubled reading of the second half of the line: "Some old tomb's ruin: yonder weed" is rendered 'rue in yonder we'd', or 'we would'. Implied then is that this old couple, who used to be entwined but are now an 'old two', would in the past have taken "up the floating weft" together, their thought combining. But in the familiarity engendered over the course of a long relationship (Browning had eloped with Elizabeth Barrett in 1846, eight years before the composition of the poem) arises a greater awareness of difference. While in the initial stages of passion, fear of being perceived as different is potentially destabilising, later, the lovers paradoxically bond (but only momentarily) through a relation of disjunctive synthesis. Yet throughout the poem, integers are repeatedly undermined by the proliferation of non-finite adverbs and adjectives, "mocking" the speaker's own attempts to grasp love. If he is unable even to count up to two, how, the poem taunts the speaker, is he able to count to infinity? Counting the "Five beetles" which aggregate in "one small orange cup" of fennel, nature suddenly reveals its "endless fleece", its "grasses everywhere!", its "everlasting wash of air".

In 'How Do I Love Thee?' (1850), Elizabeth Barrett Browning also seeks to understand love numerically. The sonnet's first line, "How do I love thee? Let me count the ways", establishes this paradoxical intent: this is a poem which will attempt to calculate the incalculable but do so by ironically refashioning the blazon.[40] Creating a spatial metaphor in which extensive properties are used to locate intensive feeling, the speaker exclaims, "I love thee to the depth and breadth and height / My soul can reach, when feeling out of sight / For the ends of Being and ideal Grace." Space contains love: but its infinite dimensions are also defined by it. Even when feeling is "out of sight", the soul reaches to the ends (in other words, not the *end*) of "Being and ideal Grace." Proceeding to list the ways in which she loves her partner— "freely," "purely," with "passion", and with a "love I seemed to lose"—the speaker of Barrett Browning's poem thus itemises and measures what is boundless by recognising its changing, non ideal nature. Indeed, in facetiously evoking the blazon, Barrett Browning undermines the notion of impermanent transcendence by demonstrating that the infinite aspects of love are realised, 'lost' and recreated through renewed action and feeling. Love rendered poetically is not to be found in a list of material characteristics: it involves a renewed oscillation through time and space.

But Barrett Browning's poetic intermeshing of the finite and infinite, extensive and intensive is more harmonious than her husband's attempt in 'Two in the Campagna'. While the thoughts and bodies of the two lovers weave in and out of one another, the final stanza of Browning's poem suggests that remaining whole, creating a

[40] Elizabeth Barrett Browning, 'How do I Love Thee?' in *Sonnets From the Portuguese* (New York: Duffield and Company, 1909), p. 50.

single ideal of love from “your part” and “my part” is only a temporary process, which recedes as soon as it is created:

> Just when I seemed about to learn!
> Where is the thread now? Off again!
> The old trick! Only I discern—
> Infinite passion, and the pain
> Of finite hearts that yearn.

In a moment of self-reflexive cognition, the speaker realises that infinity both resides in, and yet cannot be contained by, “finite hearts”. On the one hand, the paradoxical sense of epistemological stability *and* instability is emphasised in the rhyme between “learn” and “discern”. It suggests that the infinitude of love can be glimpsed in disjunction and is an understanding that can only be acquired by the divided self. But on the other, the caesuras interrupting the second and third line and the dash after “discern” break the flow of thought. Although being able to distinguish the infinite locked within the finite, the speaker is unable to quantify it. It is only in discerning the isolation of the “I”, the separate self, that he is able to appreciate the limitations of intensive thought and love.

4.3 Organic multiplicity and the dissolution of the self

If one of the central paradoxes of the poem is that the speaker’s recognition of love’s resistance to finite quantification is nonetheless accompanied by a desire to fix and “hold it”, then throughout, Nature’s fecundity taunts him. His personal anguish over the vagaries of love seem inconsequential when compared to the reproductive powers of Nature. The poem’s description of the organic world does not simply provide a physical setting in which to contemplate love. Nor is nature, despite initial appearance to the contrary, figured as a place of beauty, harmony and tranquillity. In fact, as I argue in this section, the organic world of 'Two in the Campagna' is a place of terrifying, mindless promiscuity: a region defined by a never-ending cycle of death and growth, primal urges and boundless nonhuman couplings. What makes the natural world beautiful—its lack of an ideal form, its endless change—is also what makes it grotesque. In the context of the poem's doubled yet divided nature and the speaker's attempt (but failure) to combine separate parts into a unified whole, the stanzas describing nature thus expose a tension between poetic expectation and poetic reality. On the surface, nature appears to provide a metaphor for love, with Browning succumbing to what Ruskin termed the 'pathetic fallacy'. However, Browning complicates the possibility of a connective metaphorical synthesis between nature and love. Nature threatens personal desire and, contrary to poetic expectation, resists metaphorical unification.

In his essay, 'On the Pathetic Fallacy' (1856) Ruskin outlines the "difference between the ordinary, proper, and true appearances of things to us; and the extraordinary, or false appearances, when we are under the influence of emotion or contemplative fancy".[41] The "irrational" poet, Ruskin claims, projects onto the world "false appearances" that are "entirely unconnected with any real power or character in the object."[42] As an example of this 'pathetic fallacy', Ruskin quotes the following lines from Oliver Wendell Holmes' 'Spring': "The spendthrift crocus, bursting through the mould / Naked and shivering, with his cup of gold." These lines, Ruskin claims, are beautiful yet untrue: "The crocus is not a spendthrift … its yellow is not gold but saffron."[43] In attributing emotions and 'untrue' qualities to the organic world, the 'Nature' verses of 'Two in the Campagna' appear, on first sight, to be influenced by "contemplative fancy". Indeed, the landscape is described as "feathery" and imbued with feelings of "Silence and passion, joy and peace".

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[41] John Ruskin, 'Of the Pathetic Fallacy' in *The Genius of John Ruskin: Selections from His Writings*, ed. John D. Rosenberg (Charlottesville: University of Virginia Press, 1998), pp. 61-70 (p. 64).
[42] Ibid.
[43] Ibid.

However, in a reversal of poetic expectation, Browning inverts Ruskinian pathetic fallacy. Nature in fact imposes itself onto the speaker with such force that his description of the organic reads as an anguished cry for stability amongst a terrible and shifting backdrop of nonhuman power. On the surface, lines such as "Such miracles performed in play" read as a hymn to Nature's vitality. But these lines are far more disruptive. The speaker's subjectivity, his 'oneness' is eradicated by the sheer, uncountable multiplicity of organic life. Indeed, in contemplating the awesome power of nature, the speaker passes through a moment of total deterritorialisation as his own sense of self and personal love is destroyed. Nature and by implication the female object of love, are coterminous with the poem's subject. But they do not converge: they occupy entirely different *worlds*. It is in the dawning realisation that the relation between the lovers and between the self and nature is primarily a disjunctive synthesis exposing only intensive *difference* that the possibility for convergent love is denied. The "passion and the pain" of love experienced by the poem's subject pales in comparison to the abundant multiplicity of the organic world. Animals, plants and insects do not have a consciousness with which to appreciate the complexities of desire. Yet they too, independent of any notion of the ideal, constantly produce desire. To be sure, if the differential love of the speaker resists quantification, emerging instead from the "cleft[s]" in between numbers (the one and the two), then Nature utterly defies it altogether. It too constantly produces the infinite through its terrifying productive energies.

In just "one small orange cup amasse[s] / Five beetles,—blind and green they grope / Among the honey-meal". The beetles' multiplicity (so many contained in the one) taunts the speaker: surely individual and personal love is irrelevant in a universe consisting almost entirely of nonhuman matter. Although the speaker is *aware* of the complexities of desire, he is like the beetles, blind and groping. Indeed, if thought is a biological process dependent on the body for its existence then it will inevitably, like the "yellowing fennel, run to seed". But while the awareness of love's infinity exists only so long as "finite hearts" can discern it, Nature is full of constant cycles of material decay and growth: from the cleft of the "old tomb"—a place of death—"weed" emerges "branching" out in new directions. In fact, the beetles' lack of consciousness allows them to copulate without inhibition; Nature's mindless promiscuity is driven by pure, unfettered differentiation.

By the fourth line, the speaker realises that the beetles are "Everywhere on the grassy slope". And in transitioning to the fifth stanza, the sense of Nature's virility becomes overwhelming. Its scale is both sublimely wonderful yet also terrifying as numbers fail to quantify its excess:

> The champaign with its endless fleece
> Of feathery grasses everywhere!
> Silence and passion, joy and peace,
> An everlasting wash of air—
> Rome's ghost since her decease.

The champaign's "endless fleece" is a fertile fabric of boundless nonhuman activity and pre-phenomenal thought: indeed, it is from fleece that a single strand of "thread" is wrought. Even if human thought is in someway ideal, the poem implies, it has a biological component and is thus unable fully to transcend this prepotent material realm. Produced partly from the natural organic world, the speaker's thought is also lost in such unquantifiable multiplicity. As the infinite champaign fleece absorbs thought's "floating" weft, the speaker loses his sense of self. The exclamation mark following "everywhere" in the second line hints at the shocking sense of dispossession engendered by the expansive landscape. It also conforms to Browning's repeated use of exclamation points after expressions of the infinite to emphasise its irreducibility.

Moreover, the feminine rhyme between "feathery" and "every" implies that the feminine—Nature as Mother and the speaker's companion as other—is both a gendered world the male speaker has no access to and is all encompassing. In Nature and love, the speaker experiences extremes of emotional intensity: "Silence and passion, joy and peace”. Paradoxically however, the prospect of renewed emotional mobility encountered in Nature and disjunctive love—the continual movement between states of harmonious equilibrium (silence and peace) and intense feeling (passion and joy)—underscores the speaker’s passivity in the face of relentless activity. He does not invite these changes; he is unable to seize his own thread of thought and separate it from this world. Indeed, the present moment also encompasses the past: “An everlasting wash of air— / Rome’s ghost since her decease.” In nature, as in love, the evolving fleece is never static; parts are mixed but they are never fused into a fully coherent whole. Love and the natural world are created anew from constant regeneration but are also continually turned into the ghosts of the past: an implication strengthened by the rhyme between “fleece” and “decease”.

This word, “decease”, heralds the momentary annihilation of the personal thread of thought winding through the poem as Nature’s terrifying random and morphogenetic powers reach a climax in the following verse. Both the fifth and sixth verses are notable for the absence of the singular first person “I”, or indeed, any other personal pronoun. Human thought, let alone personal love, is engulfed by the organic world. Every other stanza in the poem remains partially predicated upon an ‘I’, ‘you’, ‘me’, ‘we’ or ‘our’. But stanzas five and six exert a powerful hold over the ego throughout the poem, threatening to dispossess the selfhood of speaker and poet. The closer the lines of the poem come to these two stanzas, the more fragmented and unassertive the “I” becomes, unable to quantify, regulate and control not only the external world but also the inner world of the mind too. In the opening stanza, for example, “I” appears twice, while “you” and “we” appear once. But as the poem progresses, the orientation shifts as human agency and the assertive power of the will become subservient to the organic nonhuman. In the second verse, “I” again appears twice but “our” appears once. The decline in personal pronouns continues in verse three, which features only “me” and, if we also count the homophonic pun on “weed”, ‘we would’. And again, this decline is sustained in the fourth verse, containing as it does only a single “I”, which is immediately followed by the imperative “Hold it fast!” Directly after this cry for help, we transition into “The champaign with its endless fleece” and are faced with its incommensurability: it is impossible to hold fast what is endless.

In the four verses preceding the transition into the first of the two ‘nature’ stanzas then, there is a near perfect decline in personal pronouns respective to their parent verses: four personal pronouns in stanza one, three in stanza two, one or two depending on the inclusion of the “weed” homonym in verse three, and one in verse four. The movement is indicative of the speaker’s growing sense of powerlessness. Personal subjectivity is eroded by the overwhelming disjunction of other worlds—the material organic and the enclosed world of his now distant beloved. Although the speaker, his lover and nature all occupy, as Bryant puts it, the same heteroverse, the total lack of similarity between these worlds opens a disjunctive schism terrifying in its ability to make pure difference apparent. I, you, world. These three components no longer bear a connective relation to one another but are predicated only on a non-relation.

Hence, with the death toll rung by stanza five’s final word (“decease.”), the poem moves into its climatic centre piece defined by the extreme deterritorialisation of the speaker’s selfhood:

> Such life here, through such lengths of hours
> Such miracles performed in play,
> Such primal naked forms of flowers,
> Such letting nature have her way
> While heaven looks from its towers!

If the fifth stanza describes a sense of existential anxiety in the face of organic fecundity, then this stanza, the mid point in the poem’s clock-face measure of time, is the apotheosis of nonhuman activity. Nature’s reproductive energies are so overwhelming that human feeling is entirely expunged. While on a first reading these lines appear to praise the "miracles performed in play", contextualised against the progressive dissolution of the self in the previous verses, they in fact are repositioned as an anguished cry for stability. The anaphoric use of the adverb "such" prefixing the first four lines emphasises nature's uncountable abundance. Time has no real meaning except that "[s]uch life here"—in this present moment—can only have developed over "such lengths of hours". Organic matter and deep time are qualitative multiplicities that are unable to be quantified; the so-called "miracles performed in play" are simply expressions of mindless sexuality. Nature is uncaring and autonomous: it feels no shame in exposing its "primal naked forms" to the heavens.

All love, the poem implies, is merely a primal, material mechanism which has no function other than incessant reproduction. At first the speaker is repelled by this world, his romantic longing for ideal love set in opposition to the finite material reality upon which it rests. There is little, if any possibility of resisting the organic constraints imposed upon human intentionality. Indeed, while heaven watches dispassionately "from its towers" removed from the fervent sexual promiscuity simmering below it, the speaker too is powerless to repress love's corporeality. Regaining composure in the following stanza, he suggests that "[a]s earth lies bare to heaven above" so too should we be "unashamed". Love is not wholly ideal: one must accept that there is also a material, chemical basis to it.

Yet this moment of epiphany is nonetheless tempered by the following question, "[h]ow is it under our control"? The answer, of course, it that it is not. Love is "Nor yours nor mine, nor slave nor free!" and thus the speaker probes "the core / O' the wound, since wound must be". Deleuze, adopting the *amor fati* enunciated by the poet Joë Bousquet after sustaining a serious injury in World War I—"My wound existed before me, I was born to embody it"—argues that "[l]ove is in the depths of bodies, but also on that incorporeal surface which engenders it."[44] For Deleuze, Bousquet does not "express the unfortunate determinism of his fate" but rather, "[o]nce the injury is

[44] Gilles Deleuze, 'On the Superiority of Anglo-American Literature' in *Dialogues II*, trans. Claire Parnet (New York: Columbia University Press, 1987), pp. 36-77 (p. 63).

embodied, the personal struggle to endure and bear it [that] creates the event anew as if the injury originates in the body itself."[45] From the total dissolution of the self paradoxically emerges the recreated, distinct and stoically worthy individual: 'become worthy of what happens to you'. This is not to suggest that bodily experience is pre-destined. Instead, it implies that accepting the pre-personal forces that shape the individual can be used, paradoxically, to reclaim the "body from its relentless virtualizations and disseminations".[46] Indeed, the "return to wounding manifests a desire and a nostalgia for coherency, so that, quite ironically, woundings … involve once more the creation of material borders, surfaces, and demarcations."[47]

This is the *amor fati* partially adopted by the speaker of 'Two in the Campagna' after his terrifying encounter with Nature. Although aspects of human love emerge from the nonhuman world of desire, in probing the "core" of the wound "since wound must be", the speaker is able temporarily to reclaim his own sense of self. This, of course, is only a transient epiphany. In plunging into the depths of material multiplicity and then to the extremes of idealised love, the speaker's desire is deconstructed and reconstructed anew in the liminal lived space between these two zones. Love is neither "yours nor mine, nor slave nor free"; but nor is it the sole possession of the organic world. By accepting the material basis of love, the speaker is imbricated in a continual process of de and reterritorialisation in the disjunctive schisms that open up between himself, his lover and the natural world. By recognising the intensive forces driving individuation, the speaker enters into a process of personal individuation too: a point Browning emphasises through the reappearance of personal pronouns in stanzas eight and nine.

In these verses dealing with the incommensurability of Nature, Browning touches upon mid-century anxieties about the place of human life in the organic world. Although Darwin's *Origin* would not be published for a further five years, Browning's

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[45] Ilai Rowner, *The Event: Literature and Theory* (Lincoln, NE: University of Nebraska, 2015), p. 143.
[46] Hanjo Berressem, 'Body—Wound—Writing', *American Studies*, 44:3 (1999), 393-411 (p. 395).
[47] Ibid.

poem reflects a turn towards evolutionary ideas. He gives poetic voice to the growing de-anthropomorphisation of the natural world and the "treatment of man's 'animal' nature, where he is an animal like others, produced by the forces of evolution."[48] Indeed, in its depiction of the dissolution of the self and personal love in the face of organic multiplicity, 'Two in the Campagna' is remarkably attuned to emergent evolutionary ideas.

Lyell's three volume *Principles of Geology* (1830-1833) had suggested that the earth was extremely old and formed by natural processes taking place over vast periods of time. The French naturalist John Baptiste de Lamarck, meanwhile, was among the first to propose that life developed from simple to increasingly complex organisms. Although Darwin would later reject Lamarck's teleological notion of progression—replacing the image of a steady upwards climb with the branching tree of life—these evolutionary ideas had been in circulation for a while. In England, Robert Chambers' anonymously published *Vestiges of the Natural History of Creation* (1844) "made evolution an acceptable—as well as accessible—topic of polite discussion and brought it into the middle class home."[49] Hence, as C. Leon Harris notes, "[a]t least a dozen scientists had proposed theories of evolution before 1837, when Darwin began his first notebook on the subject" and "at least two dozen others kept reinventing the idea before the publication" of *Origin*.[50]

Moreover, the now famous phrase depicting Nature locked in violent struggle—"Nature, red in tooth and claw"—is taken from Tennyson's *In Memoriam*: a poem written between 1833 and 1850.[51] Browning also concretises these nascent ideas in his depiction of nature's terrifying promiscuity and the threat it poses to stable notions of the self. Although his encounters with these discourses are difficult to locate with

[48] Bruce Mazlish, *The Uncertain Sciences* (New Haven: Yale University Press, 1998), pp. 132-33.
[49] Bernard Lightman, 'The popularization of evolution and Victorian culture' in *Evolution and Victorian Culture*, eds. Bernard Lightman and Bennet Zon (Cambridge: Cambridge University Press, 2014), pp. 286-311 (p. 288).
[50] C. Leon Harris, *Evolution: Genesis and Revelations: With Readings from Empedocles to Wilson* (New York: State University of New York, 1981), p. 132.
[51] As Gold argues, "Tennyson ... helps set up Charles Darwin" by already developing "a notion of evolution as onward-and-upward progress". *ThermoPoetics*, p. 15.

precision, Browning's later correspondence indicate that he took an active interest in them. Certainly, he regarded himself as in touch with new scientific theories, especially evolutionary biology, and was irritated by suggestions to the contrary. As he wrote in a letter to Frederick James Furnivall:

> [A]bout my being 'strongly against Darwin, rejecting the truths of science and regretting its advance'—you only do as I should hope and expect in disbelieving *that*. ... In reality, all that seems *proved* in Darwin's scheme was a conception familiar to me from the beginning: see in *Paracelsus* the progressive development from senseless matter to organized.[52]

Written in 1881, Browning's comments must be treated with a degree of scepticism. But it does seem, even recognising the problems of hindsight, that Browning at least recognised evolution before it had been scientifically defined. *Paracelsus* was written in 1840, nineteen years before Darwin's *Origin*. Even then, Browning claims in his letter, he had explored the "progressive development from senseless matter to organized." Moreover, in his 1851 *Essay on Shelley*, Browning uses an evolutionary metaphor to describe the crepuscular forms of objective thought buried deep within Shelley's subjective poetry. "[W]hy not regard," Browning wonders, "the less organised matter" of 'Cenci' and 'Ode to Naples' "as the radiant elemental foam and solution, out of which would have ... evolved, eventually, creations" of objective poetry?[53]

While it is difficult directly to trace Browning's engagement with evolutionary discourses, his pre-Darwin writings nonetheless concretise the anxieties engendered by the emergence of a new material worldview. In the "delicate, early stages of a scientific development, before a phenomenon has been named or a hypothesis adequately articulated", writes Gold, literature "participates in creating as well as expressing the cultural milieu" from which these ideas are generated.[54] In his exploration of the

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[52] Robert Browning, letter to F. J. Furnivall, 11th October 1881 in *Letters From Robert Browning to Various Correspondents*, ed. Thomas J. Wise, 2 vols (London: Privately Printed, 1895), I, 80-85 (pp. 82-83).
[53] Browning, 'Shelley', pp. 72-73.
[54] Gold, *ThermoPoetics*, p. 15.

fecundity of nature, Browning's poem crystallises a charged moment in time when stable notions of the self were coming under threat and transcendent ideals were being destabilised by new material knowledge. As Isobel Armstrong notes, 'Two in the Campagna' was written "in an era that was gradually losing a culturally shared language for the ineffable of teleological religious experience … and seeking another that would search into other forms of the ineffable."[55] Complicating Gold's suggestion that burgeoning evolutionary narratives were "taken to imply onward and upward development", Browning's representation of organic multiplicity brings about the temporary dissolution of the self and draws attention to the "interstices and disjunctions" of poetic epistemology.[56] Like the speaker's imploding thought, Browning's poem is itself unable to capture or resist the overwhelming power of "[s]uch life". All he can do is watch as human intentionality is, across the central two stanzas, subordinated to nonhuman organic desire.

4.4 Touching the flesh; touching the soul

Given the incessant folding and refolding of love in the poem, the speaker is able only momentarily to grasp it. Indeed, the opposition between touching and not touching, holding and not holding, is another crucial disjunction explored by Browning.

Throughout 'Two in the Campagna', the speaker ponders the paradox of love's actualisation through extensive material acts. A moment of physical intimacy unites two bodies yet these singular events have a finite duration. As soon as they are realised, they begin to melt in the past. "[H]and in hand", the lovers would sit down on the grass and while the memory of this event remains, its intangibility in the present moment frustrates the speaker. For Deleuze,

[55] Isobel Armstrong, 'Syntax' in *The Oxford Handbook of Victorian Poetry*, ed. Matthew Bevis (Oxford: Oxford University Press, 2013), pp. 122-29 (p. 126).
[56] Gold, *ThermoPoetics*, p. 41; Armstrong, 'Syntax', p. 127.

sensation belongs to a different order and possesses an existence in itself for as long as the material lasts. The relationship of sensation must therefore be assessed within the limits of the duration ... In the first case *sensation is realized in the material* and does not exist outside of this realization. ... In the second case it is no longer sensation that is realised in the material *but the material that passes into sensation* [emphasis original].[57]

It is this reality the speaker struggles to accept. Indeed, recognising the gap between his inner world and the world occupied by his lover, the speaker nonetheless desires to become one with his beloved by imbibing her bodily processes and sensations. Having been rent apart by the terrifying natural world and seeing that control over his own "floating weft" of thought is all but impossible, the speaker is still unable fully to incorporate this knowledge. Indeed, in his yearning for transcendent union with his partner, the speaker's continued resistance to the ontological instability of desire represents an inevitable return to the conditions with which he is trying to free himself. The ninth stanza describes this unfulfilled longing in both prostrate and aggressive language:

I would that I could adopt your will,
See with your eyes, and set my heart
Beating by yours, and drink my fill
At your soul's springs ,—your part my part
In life, for good and ill.

The final line of the verse echoes traditional marital vows and implies that coming into contact with both the "good and ill" of his partner's experiences is the key to their successful weaving together. But while the speaker is willing to surrender his own will to "adopt" his lover's this act is shown to be as selfish as it is apparently selfless. Incorporating another's will necessarily implies that they themself relinquish control: as the following line makes clear, the speaker wants to "see with your eyes". "[S]et my heart / Beating by yours" constitutes an attempt to synchronise the two lovers'

[57] Deleuze and Guattari, *What is Philosophy?*, p. 193.

movement through time. However, the prominence of “Beating” on the line also draws attention to the undercurrent of violence—the sense that the speaker is exerting force upon his lover. And in rendering it as clock, the heart—supposedly a place of infinite feeling—is once again atomised and broken into “your part and my part”. In this context, the word “springs” in the fourth line conjures an image of a mechanical spring, further emphasising the disjunction between qualitative feeling and quantitative systematisation.

Frustrated by the inability to unite his and his lover’s worlds, the speaker expresses primal urges like the natural world he has just observed: “drink my fill / At your soul’s springs”. Yet this greediness is counterbalanced by its impossibility. Each attempt to touch, gasp, or control his lover’s soul is denied by the poem’s structure, the following stanza opening with the word “No”. Even touching the flesh, retaining a hold on love actualised through brief moments of physical contact, is denied. Like the ascetic Brother Lorenzo in ‘Fra Lippo Lippi’, the speaker wants to fix the infinitude of love in material form: “all I want’s the thing / Settled for ever one way.”[58] But, as he should recognise by now, this is a futile endeavour. The tenth stanza embodies this frustrating oscillation between material tangibility and intangibility:

> **X**
> No. I yearn upward, touch you close,
> Then stand away. I kiss your check,
> Catch your soul’s warmth,—I pluck the rose
> And love it more than tongue can speak—
> Then the good minute goes.

In plucking “the rose” and loving it more than his “tongue can speak”, the speaker holds on to what is essentially a dead object. The rose needs to be rooted in the ground and nourished with water, minerals and light in order to live. But in acquiring it as a material possession, the speaker inadvertently kills it. Likewise, catching the “soul’s

[58] Browning, ‘Fra Lippo’, p. 546.

warmth" implies that it will soon be cold. It will fade in time as "the good minute goes"— a "love grown chill" as Browning elsewhere writes.[59] Indeed, in the following verse, the speaker is (still) surprised that the material present continually evades his grasp. "Already how am I so far / Out of that minute?"

Repeatedly, the speaker finds that he is unable to touch what was once living. The strand of "floating weft"—a material image of the speaker and Browning's thought—weaves through the poem, yet remains elusive: "I touched a thought, I know / Has tantalized me many times". The imperative demanding "[h]elp ... to hold it" in the third stanza is instantly undercut by the following words: "it left". Again, in the next verse, the speaker "trace[s]" his intangible thought but is unable to "[h]old it fast!" The poem seems to continually taunt its own persona. Indeed, the failure of imperative commands is further emphasised through words ordinarily suggesting contact and ownership, but that in the context of the poem, in fact imply distance and lack. "Fixed", "close", "catch"—each of these terms is negated by an antonymic phrase: "Off again!", "I go", "stand away", "let go". Browning's implication here is twofold. Love is generated intensively: through ephemeral thoughts, actions and bodily sensations that do not exist in an idealised form. It is preserved *in*, but also lost *by* memory. Because it is predicated in part on matter, love must be experienced through the body. Yet, problematically, it can only be experienced fleetingly as love is ever changing, constantly eluding possession. Love is thus paradoxically material and immaterial, ideal and non-ideal. It stretches from the past to the present but can only be experienced in the immediacy of the moment.

This is what Browning means when he writes in his *Essay on Shelley* that the realist poet's job is to embody in verse "the picturesque groupings and tempestuous tossings of the forest-tree, but with their roots and fibres naked to the chalk and stone."[60] The surfaces of things, in other words, are produced from the connected and connective "roots and fibres" spreading through the material world. The tree will

[59] Browning, 'In a Year', (1855), *The Poems*, I, pp. 653-55 (p. 653).
[60] Browning, 'Shelley', pp. 38-39.

eventually die. But the poet's duty is to concretise in verse its construction and evolution by rebuilding it anew in language. "The value and significance of flesh" is therefore, as Fra Lippo Lippi claims, that it simultaneously contains and is produced by excess; in engaging with the flesh, the "soul revolves".[61] But the inherent problem encountered by Browning and the speaker of 'Two in the Campagna' is that when "the cup runs over" the moment of concretisation is lost: the moment the soul is touched through the flesh, it spills out or recedes and must be recreated anew.[62]

'In Three Days' (1855), a poem marking in increments the time until the speaker will next see his beloved, also explores the idea that material stuff contains and produces intensive, soulful energy that can only be experienced in the present moment. Touching his lover's "loaded curls" of hair, the speaker implores them to "release your store / Of warmth and scent."[63] Employing the semantics of both electricity and thermodynamic energy, the verse continues as the speaker delves into the charged mass of hair:

> The tingling hair did, lights and darks
> Outbreaking into fairy sparks,
> When under curl and curl I pried
> After the warmth and scent inside,
> Through lights and darks how manifold—

The impression here of physical tangibility, imparted through sensorial words such as "tingling", "sparks", "warmth and scent", suggests a "manifold" cluster of sense. But the interplay between "lights and darks" implies that this is not a fixed store of energy to be retained but a dynamic process of transformation and loss. In the following stanza, Browning echoes 'Two in the Campagna' as his speaker is forced to come to terms with the temporal ephemerality of material touch: "This minute, it dies out in scorn." Again, time and matter mock the speaker; "years must teem with change … / With chance not

[61] Browning, 'Fra Lippo', p. 546.
[62] Ibid.
[63] Browning, 'In Three Days', *The Poems*, I, pp. 652-53.

easily defied, / With an end somewhere undescried." The undiscerned road ahead, the poem implies, might not bear any relation to this present moment. The lover's lights, the warmth transmitted through her "tingling hair", "might change as well" into darkness.

Browning's speakers, and by extension, himself as realist poet, constantly struggle with the disjunction between the romantic yearning for completion and the finite materiality of love. Like the lover's curls loaded with dissipating energy, language simultaneously stores and loses potency. As the convoluted interaction of consciousness in 'Dis Aliter Visum' (1864) suggests, the infinitude of the soul can only be touched in time. It cannot be held or retained but must inevitably dissipate:

> Perfect the hour would pass, alas!
> Climb high, love high, what matter? Still,
> Feet, feelings, must descend the hill:
> An hour's perfection can't recur.[64]

What Browning recognises is the fundamentally counter-intuitive proposition that the material world produces the soul: it does not exist in untouched ideal form without the interaction of things and experience. And yet, the ideal, like incorporeal material properties such as movement, cannot be fixed by material means. If one were able to freeze time, movement would instantly disappear. Likewise, the act of recreating "the world in an embodiment of verse" concurrently brings about its disembodiment.[65]

If poetry is to deal with "a supply of the fresh and living swathe ... by breaking up the assumed wholes into parts of independent and unclassed value", how then is language, itself a finite, material construct, able to embody the intensive in verse?[66] How, in other words, can it create a doubled grammar of the material and ideal if it too is only able momentarily to 'touch' the excesses of reality? How can finite words

[64] Robert Browning, 'Dis Aliter Visum; or, Le Byron De Nos Jours', *Dramatis Personae* (London: Chapman and Hall 1864), pp. 47-54 (p. 50).
[65] Browning, 'Shelley', p. 51.
[66] Ibid., p. 44.

capture something of the infinite? In Browning's poetry, this problem is never settled. Rather, it is by exposing readers to this disjunctive paradox that Browning creates a poetics of process. The very act of reading, the motion imparted by the reader to a text, momentarily revitalises a qualitative multiplicity of duration that instantly vanishes at the point reading ceases. Love is inscribed in the material but continually overwritten.

Earlier in the chapter, attention was drawn to the segmented, clock-like structure of the poem, with its sixty lines representing the sixty minutes of an hour, divided into groups of five by stanzas numbered I–XII. It is in the poem's form that these problems are most profoundly realised. The regimented structure of 'Two in the Campagna' reflects the speaker's desire to 'hold fast' the infinitude of love. Yet the poem mocks his and Browning's attempts to do so. As we have seen, in the act of reading the poem, the organic world, the intangibility of intensive love, the excessive qualities of language and the palimpsestual interweaving of time, produce a complex poetic multiplicity. Yet the poem's structure and its finite arrangement of words, ensure that this multiplicity constantly oscillates between the qualitative and quantitative. At the same time as it creates intensive affects anew, the poem also erases them. Like the speaker's attempt to touch his tantalising weft of thought, the poem embodies the process of "catch[ing] at and let[ting] go." Indeed, the almost futile efforts to 'put the infinite in the finite' is suggested in the second stanza:

> Has tantalized me many times
> (Like turns of thread the spiders throw
> Mocking across our path) for rhymes

The rhyme of "times" with "rhymes" encapsulates the speaker's and Browning's efforts to contain intensive duration in a fixed, ordered system. But the almost lackadaisical "times/rhymes" coupling draws attention to the artifice of poetic composition. The poem shows itself to be no more successful at containing or reducing love than the speaker, self-reflexively invoking its own failure.

The seemingly endless process of learning and forgetting, touching and relinquishing is as frustrating for the speaker as it is for the reader. "Must I go … Onward, whenever light winds blow, / Fixed by no friendly star?" he ponders exasperatedly, adding with self-reproaching annoyance, "[j]ust when I seemed about to learn!" It is only in the final verse that the poem and the speaker achieve a partial equilibrium with the realisation that the "passion, and the pain" of love's infinitude is actualised in the temporary moment, in "finite hearts that yearn." Indeed, it is from the inability to connect with the other, the disjunctive synthesis between worlds, that desire is paradoxically created. But it is a process, lived and poetic, that has to constantly be reconstructed anew. Failure is an inherent aspect of love and 'Two in the Campagna' is remarkable in its embodiment of this paradox and its refusal to reconcile this dilemma in its own material form.

4.5 Conclusion: Browning's disjunctive realism

With its "placid flock" and "pastor vociferant," denominational worship is a poor way to approach the numinous, believes the speaker of 'Christmas-Eve' (1850).[67] The "immense stupidity" of the sermon he has just endured had no clear line of thought: "a mingled weft / Of good and ill!"[68] Instead, the soul must be drawn out of and fashioned from the raw experiential stuff of life, just as

> the artist,
> Who, examining the capabilities
> Of the block of marble he has to fashion
> Into a type of thought or passion, —
> Not always, using obvious facilities,
> Shapes it[69]

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[67] Browning, 'Christmas-Eve', *The Poems*, I, pp. 463-96 (p. 468).
[68] Ibid., p. 467; 468.
[69] Ibid., p. 481.

From the material world and all it encompasses, fleshly bodies, beating hearts, pure sensation and natural divergence, thought and passion shape the real but disjunctive ideal. Love's infinite excesses and the transcendent are not static, higher realms but immanent to material reality. They are generated, erased and continually modified anew by the convergences and complexities of people and things wending through time. For Browning, the disjunctive aspects of the material world are not "[t]o be passed over."[70] Instead, these tensions must be "dwelt upon", simultaneously embodied and divested in poetic construction.[71] 'Two in the Campagna' is remarkable in its ability to compress such expansive concerns into so small and tightly structured a literary space, while at the same time, self-reflexively deconstructing its own poetic authority. Both the speaker and the poem never find an easy resolution to these problems, beyond the partial recognition that the infinitude of love derives from, and is felt by, transient, finite hearts. In 'yearning' to close the gap between lovers and the world, desire is, paradoxically, renewed and reindividuated.

The vibrant indeterminacy of bodies and consciousness are, for Browning, as grotesque as they are beautiful. But it is from the messy interactions of matter that the soulful and ideal dimensions of life arise. On every level—structure, content, language—Browning's poetry teeters on the liminal threshold between these zones. Appealing not, as subjective poets do, to a divine logos or inner power, the objective poet, Browning claims, must consider the "constitution of body as well as mind."[72] What makes 'Two in the Campagna's' exploration of love fundamentally intensive is its refusal to accept it as solely ideal and transcendent. Thus the Romantic yearning for eternal completion—you plus me equals one—has to contend with the material aspect of desire. This is a "pure crude fact / Secreted from man's life when hearts beat hard, /And brains, high-blooded, tick."[73]

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70 Browning, 'Fra Lippo', p. 547.
71 Ibid.
72 Browning, 'Shelley', p. 68.
73 Robert Browning, 'The Ring and the Book' in *The poetic and Dramatic Works of Robert Browning*, 6 vols (Boston and New York: Houghton, Mifflin and Co., 1891), III, pp. 1-31 (p. 2).

For Joseph Hillis Miller, writing in 1963, Browning's "first principle" is "to make the words of the poem participate in the reality they describe … He wants his words to be thick and substantial, and to carry the solid stuff of reality."[74]. Miller is one of the few critics to appreciate the intensities of Browning's poetry: its attempt not to abstract but to concretise the stuff of life and the processes which bring emotion, sense, and things into reach. "Browning," Miller continues,

> wants to make the movement, sound, and texture of his verse an imitation of the vital matter of its subject, whether that subject is animate or inanimate … He thinks of matter, in whatever form, as something dense, heavy, rough, and strong-flavored … Things are not made of smooth appearances, but of the dense inner core which is best approached through heavy language.[75]

To be sure, many of Browning's poems, especially those written during his 'middle period', constitute a study in the transference of affect: between people and material stuff. He is not interested in representing an abstract ideal so much as people "perplext with impulses" in their attempts "[t]o find … meaning" in a material world that's "no blot … / Nor blank" but "means intensely".[76] The "stimulating," "galvanic" effect of his verse—his attempts to recreate with words the intensity of lived experience—marks Browning as a poet of disjunctive real.

It was precisely these qualities that led Henry James to claim of Browning, "the real is his quest, the very ideal of the real, the real most finely mixed with life".[77] For James, the material heterogeneity of Browning's poetry was unique. In his essay on 'The Novel in "The Ring and the Book"' he compares the poem to a "vast" "clustered hugeness or inordinate muchness": an "essentially gothic … structure, spreading and soaring and branching".[78] James' admiration for Browning's works is reflected in his

[74] Joseph Hillis Miller, *The Disappearances of God: Five Nineteenth-Century Writers* (Cambridge, MA: Harvard University Press, 1963), p. 118.
[75] Miller, *Disappearance of God*, pp. 119-20.
[76] Browning, 'An Epistle Concerning the Strange Medical Experience of Karshish, the Arab Physician' in *The Poems*, pp. 565-73 (p. 570); 'Fra Lippo Lippi', p. 548.
[77] Henry James, 'The Novel in "The Ring and the Book"' in *Notes on Novelists* (New York: Charles Scribner's Sons, 1914), pp. 385-412 (p. 396).
[78] Ibid., p. 385.

own writing, crammed full as it is with strange objects, hazy surfaces and the "branching" tendrils of uncanny material power. But if Browning's poetry of the 1850s gestured towards latent anxieties concerning the onset of a new intensive view of matter, then James' works realise the full horror of unruly stuff. As the following chapter argues, human subjects and nonhuman objects had by the *fin de siècle* failed to find an equitable balance with one another. In fact, the Victorians' uneasy relationship with matter had become injurious.

CHAPTER FIVE

Haunted objects and objectile hauntings: possessed and possessive things in the works of Frederic Harrison and Henry James

Introduction: stone cold theft

The Aegean Sea, just off the southern shore of Kythera, 17th September 1802. A storm is raging. Wind and rain batter a cargo ship marooned outside the harbour of Avlemonas; churning waves spew water onto the boat's deck. The *Mentor* is in trouble. In an attempt to stabilise the vessel, Captain William Eglen orders his crew to cast the anchors but they fail to catch on the seabed. The men frantically wrestle with the violently rocking ship but are powerless to avert the inevitable. Just after 2pm the *Mentor*'s prow smashes into the rocky shoreline and along with its precious cargo plummets into the ocean's depths.

A few days earlier, a group of men had gathered on the Athenian Acropolis at the behest of Thomas Bruce, seventh Earl of Elgin and British Ambassador to the Ottoman Empire. Over the past two years, Elgin had overseen the removal of the sculptures, metopes and friezes of the Parthenon, exporting them back to Britain as per an agreement he had apparently made with the occupying forces. On this particular day, the men acting under Elgin had come to claim a metope portraying a centaur grappling with a woman. But the ancient stonework proved difficult to remove. Giovanni Lusieri, the Italian painter appointed by Elgin to orchestrate the removals, had to break the stone lintel that ran above the metopes. Even then, the panels were attached horizontally with two and a half thousand-year-old iron clamps that had to be ripped from their joints. The temple put up a struggle but Lusieri and his men were not fazed. They smashed, wrenched and pulled apart the carefully engineered masonry and eventually looked on triumphantly as huge stone slabs smashed on the ground below. The metope was free. In a letter to Elgin, Lusieri described his victory:

> I have, my Lord, the pleasure of announcing to you the possession of the 8th metope, that one where there is the Centaur carrying off the woman. This piece has caused much trouble in all respects, and I have even been obliged to be a little barbarous.[1]

Of course, in Lusieri and Elgin's view, such barbarity was entirely justified. Unless they were put under the protection of the British government, the Parthenon marbles would surely come to great harm at the hands of the febrile Turks.

Elgin purchased the brig *Mentor* in January 1802 to transport the Pentelican statues to Britain. On the 15th September the ship was loaded with seventeen crates containing antiquities seized from the Parthenon. Now, two days later, the treasures lay submerged beneath seventy feet of water. They would remain there until local fisherman, with extraordinary skill and effort, salvaged them from the seabed and returned them to the British. But for that brief time they remained underwater the ancient stones evaded human possession. They had no master except the forces of nature.

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Nearly a hundred years after these events, the Parthenon marbles sat in hermetically sealed cases housed by the British Museum. They were one of thousands of public and private collections of material objects, artefacts, specimens and curiosities that had been amassed by collectors over the course of the nineteenth-century. The Victorians' relationship with things was intimately connected to how they perceived time and their place in it. As Steven Conn argues, in gathering, possessing and displaying objects, the Victorians constructed narratives about their lives and were able to communicate with

[1] Giovanni Lusieri, letter to Lord Elgin, 16 September 1802. As quoted in Christopher Hitchens, *The Parthenon Marbles: The Case for Reunification* (London and New York: Verso, 2008), p. 16.

others their beliefs and desires.[2] While the public storage of objects could preserve traces of the past for future generations, for others, like the mourning Queen Victoria, objects were intensely private things—the last remaining trace of the dead. For years after Prince Albert's death, the queen would go to sleep "clutching her dead husband's nightshirt" and have his unused chamber pot cleaned each morning.[3] Yet objects, while being constantly produced, were also being constantly replaced. They were ubiquitous yet strangely ephemeral. Possessing objects and using them to construct narratives of selfhood was a potentially uncanny, even violent undertaking. Newly manufactured objects were abstracted from the conditions of their production while heirlooms, cultural treasures and inherited objects could reveal surprising, unpleasant histories. Objects could also act in seemingly autonomous and unsettling ways. They too had the power to possess and haunt.

These concerns were especially important to the essayist Frederic Harrison and novelist Henry James, whose writings are the focus of this chapter. Both share, in the words of Gillian Beer, late nineteenth-century "anxieties about … oblivion [and] the remoteness and unreclaimableness of origins".[4] But they also share a strange fascination with the peculiar objectivity of subjects and the subjectivity of objects. In particular, they are concerned with the effect nonhuman and human relations have on the past: how the inheritance, acquisition and possession of things are ambivalent, complicated and even ethically fraught processes. The past was a malleable entity. It could be constructed, erased, desecrated or preserved but it could also bubble up from obscured depths to disturb the seemingly still waters of the present. These are anxieties that emerge directly from the conceptual shifts of the last fifty years. Intensive matter, considered from scientific, cultural and everyday perspectives, had shown the Victorians that neat boundaries separating subjects and objects were often arbitrary

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[2] Steven Conn, *Museums and American Intellectual Life, 1876–1926* (Chicago and London: University of Chicago Press, 1998), pp. 8–9.
[3] Greg King, *Twilight of Splendor: The Court of Queen Victoria During Her Diamond Jubilee Year* (Hoboken, NJ: John Wiley & Sons, 2007), p. 40.
[4] Gillian Beer, *Arguing with the Past: Essays in Narrative from Woolf to Sidney* (London: Routledge, 1989), p. 12.

constructions. By the fin de siècle, these realisations were pervasive but they had not been successfully assimilated; recalcitrant stuff was as much a problem for literary authors as it was for scientists

Recent critical theories of objects share a similar concern with the peculiar qualities of material things and their often unsettling interactions with humans. For John Plotz, 'thing' is the term of choice to describe the elusive aspects of objects that cannot be defined adequately with nouns.[5] For Bill Brown, meanwhile, the notion of 'thingness' affords "a grittier, materialist phenomenology of everyday life".[6] In *A Sense of Things* (2003), Brown frames the production, circulation and accumulation of objects in modernist life as a problem of consumption. Citizens of the late nineteenth and early twentieth centuries found themselves unable to possess objects, in spite of the abundance of material goods. In a commodified culture where subjectivity was itself abstracted, people became increasingly disconnected from their environments. Brown's work is a spellbinding account of the attempts and failures to construct narratives of selfhood through material objects. Yet in spite of the profusion of objects in his book, Brown's focus is always on "how inanimate objects constitute human subjects".[7]

While Brown's theory of commodified subjectivities influences this chapter, I attempt to redresses his anthropocentric imbalance by drawing on Deleuze's concept of the 'objectile'.[8] In *The Fold* (1993), Deleuze coins the term to describe how an object (a compound perhaps of object and projectile) unfolds through space *and* time. A manneristic event with direction and magnitude, the objectile leaves behind material traces of its past. Yet "no longer refer[ring] its condition to a spatial mold … but to a

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[5] John Plotz, 'Can the Sofa Speak? A Look at Thing Theory', *Criticism*, 47.1 (2005), 109-18 (p. 109).
[6] Bill Brown, *A Sense of Things: The Object Matter of American Literature* (Chicago: University of Chicago Press, 2003), p. 3.
[7] Bill Brown, 'Thing Theory', *Critical Inquiry*, 28 (2001), 1–22 (p. 7); Brown, *Sense of Things*, p. 18.
[8] For recent discussion of 'object-oriented-ontology', see Levi R. Bryant, *The Democracy of Objects* (Ann Arbor: Open Humanities Press, 2011) and Graham Harman, *Guerrilla Metaphysics: Phenomenology and the Carpentry of Things* (Chicago: Open Court, 2005).

temporal modulation" it thus has the capacity also to affect the present and the future.[9] It is no longer a noun but a verb. Moreover, Deleuze continues, "[i]f the status of the object is profoundly changed, so also is that of the subject."[10] Like objectiles, the subject is not fixed but transforms and is transformed by nonhuman things moving through time—sometimes in ways that are unpleasant and destructive.

This chapter makes similar claims regarding the object-matter of Harrison and James' texts, tracing their portrayal of the possessive relationships between humans, objects and time. First I discuss Harrison's claim that housing the Parthenon marbles in the British museum leads to the suppression of the "weird but silent message from the past".[11] Virginia Zimmerman has analysed Harrison's essay alongside other periodical writing on preservation tactics, in light of John Baudrillard's work in *The System of Objects* (1968) and Jacques Derrida's notion of the trace.[12] While Baudrillard's work is concerned with how a collector alters the meaning of an object by removing it from its original context, Derrida suggests that the trace, rather than being an empirical marker of the endurance of the past, attests instead to the changeable nature of the sign and its replacement of, and transformation into, its own origin.[13] These ideas feed into my argument but it diverts from Zimmerman's in its reassessment of Harrison's positivist idealism. For Harrison, positivism was not, as one Victorian critic put it, a "faith ... founded on a myth ... which is 'facts alone'".[14] It was an ethically conscious philosophy belonging "to the spiritual".[15] Hence, Elgin's removal of the marbles is for Harrison more than simply an act of imperial aggression; it also represents an attack on the past.

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[9] Deleuze, *The Fold*, p. 20.
[10] Ibid.
[11] Frederic Harrison, 'Give Back the Elgin Marbles', *Nineteenth Century*, 28 (1890), 980–87 (p. 983); Jean Baudrillard, *The System of Objects*, trans. James Benedict (London)
[12] Virginia Zimmerman, '"The Weird Message From the Past': Material Epistemologies of Past, Present, and Future in the *Nineteenth Century*', *Victorian Periodicals Review*, 42:2 (2009), 114–13.
[13] Jacques Derrida, *Of Grammatology*, trans. Gayatri Chakravorty Spivak, (Baltimore: Johns Hopkins University Press, 1997), p. 61.
[14] Francis Peek, 'The Arrogance of Modern Scepticism', *The Contemporary Review*, 29 (1881), 571-83 (p. 577).
[15] Frederic Harrison, 'The Religious and Conservative Aspects of Positivism', *The Contemporary Review*, 26 (1875), 992-1012 (p. 993).

Following this, the chapter examines how attempts by museum curators to create visual cartographies of time were disrupted by objects in their own collections. In *Pasts Beyond Memory* (2004), Tony Bennett demonstrates how museum curators in the late nineteenth-century used fossils, bones and cultural objects to predicate ideological narratives of progress. Building on this work, I argue that Victorian evolutionary exhibitions were sites of contested time. However, in contrasting the epistemological gaps created by ancient fossils with the temporal wounds inflicted upon the Parthenon marbles, it demonstrates the potentially productive value of aporia. Both variants of unstable temporal-material circuits are essential to my reading of Henry James' late texts as disturbing literary experiments into the workings of possessive power. The suppression of 'thingness' in *The Spoils of Poynton* (1896)—a story of female disinheritance—creates a tale marked by gaps and scars. The heroine of the novel, Fleda, is all too aware of these wounds and constantly struggles with the objectification of her own subjectivity. While the novel exposes how patriarchal inheritance laws inflict violence upon women, the manner in which James constructs his narrative remains, I argue, deeply ambivalent.

The characters of *The Turn of the Screw* (1898) are also pulled apart by human and non-human forces. James' ghost story uses various manifestations of force—electrical, tensile and supernatural—to trace the networks of power between people and things. Moreover, the past returns with a demonic ferocity, devouring interpretative energy to power a continually haunted *and* haunting textual object. What is terrifying about James' texts is the lack of easy resolution—the failure for his characters and texts-as-objects to find an equitable balance of possessive energy.

5.1 (Not) written in stone

Nearly a hundred years after Elgin's removal of the Parthenon marbles, Harrison published a strident essay in the monthly periodical *Nineteenth Century*. 'Give Back the

Elgin Marbles' (1890) called for the immediate return of the statues to the Acropolis, rejecting as "sophism" claims that Britain was acting as a necessary caretaker in the face of Greek archaeological, political and economic recklessness.[16] Greece had achieved independence from Turkish rule in 1832, thus Harrison was able to frame his argument in terms unavailable to earlier critics of Elgin. Suggestions that the stones would suffer from Ottoman indifference, vandalism, or as a result of the country's inability to provide an adequate system of care had lost traction.[17] In fact, evidence seemed to point to the contrary. Restoration work on the Acropolis had begun almost immediately after 1832 and doubts were cast over Elgin's supposed deal with the Turkish government.[18] Moreover, the marbles' safety was, according to Harrison, no less assured than if they were housed in Paris, Berlin, Vienna, or Rome—cities that had been the stage for "fearful street battles" over the preceding decades.[19]

In accordance with his legal background and positivist beliefs, Harrison's argument is supported by a steady succession of seemingly self-evident facts. London's smog and poor air quality, for instance, are inimical to the stones' physical constitution. Visitors to the British Museum, claims Harrison, will "observe the cruel scars" left by Lord Elgin and see that they are being "subtly filled with London soot."[20] If the environmental climate of Athens was superior to London's, so too was its cultural climate. "Athens," Harrison writes, has become "a far more central archaeological school than London."[21] Certainly, the Parthenon suffered damage during the two Athenian sieges in the 1820s and was the subject of territorial battles and unregulated building works. However, with the founding of the Greek Archaeological Society in 1830, the Acropolis' was recognised as a site of artistic, national and historical significance.

[16] Harrison, 'Marbles', p. 980.
[17] Hitchens, *Marbles*, p. 61.
[18] Jeanette Greenfield, *The Return of Cultural Treasures*, 2nd edn (Cambridge: Cambridge University Press, 1996), p. 55.
[19] Harrison, 'Marbles', p. 981.
[20] Ibid.
[21] Ibid., p. 980.

Restorative work began immediately. "These stones are more precious than rubies or agates," claimed the society's first President, Iakovos Rizoz Neroulos. "It is to these stones that we owe our rebirth as a nation."[22] The Acropolis' centrality to Greek cultural identity is of great importance to Harrison too; it stands as a "great national symbol" of both the country's past and its newfound identity.[23] For Harrison then, the Act of Parliament passed in 1816 allowing the British Museum to purchase the stones for £35,000 was not an act of preservation but of theft. Accordingly, Harrison appeals to the English sense of fair play, asking his readers to recognise the site-specific resonance of cultural artefacts: "[i]t is enough to make the cheek of an honest Englishman burn when he first sees the ghastly rents which British … taste tore out of this temple".[24]

Harrison's petition to the English sense of national and cultural sovereignty thus engages with wider Victorian discourses concerned with memorialising the past for posterity. Objects, texts and buildings, he argues, occupy a spatial and temporal juncture between past and present. They are, in other words, comprised of both physical form and compressed personal, collective, and national memories. Time is an extricable component of objects and the acquisition, storage and preservation of cultural artefacts must, Harrison reasons, be predicated on this tenet. As he wrote in another 1890 article for *Nineteenth Century*: the concern of preservationists should not simply be "a passion for *looking backwards*". It should also be for "*looking forwards* [emphasis original]".[25]

Harrison thus believes that objects need to be stored in a way that preserves their materiality and temporality. They do not exist in isolation; rather, their meaning emerges from their constitutive arrangement in a wider circuit of communication. "The original should be set up as a whole", he writes. The marbles need to be seen "in their

[22] As quoted by Robert Browning, 'The Parthenon in History' in Hitchens, *The Parthenon Marbles*, 1-16 (p. 13.)
[23] Harrison, 'Marbles', p. 982.
[24] Ibid., p. 984.
[25] Frederic Harrison, 'A Pompeii for the Twenty-Ninth Century', *Nineteenth Century*, 28 (1890), 381–91 (p. 381).

native sky and under all the complex associations of that most hallowed spot".[26] Stored in the British Museum, the very quality that marks them as unique parts of a greater architectural vision is abolished. Hence, echoing the sentiments of Neroulos, the marbles are, Harrison writes,

> the national symbol and palladium of a gallant people … far more important and sacred than are any other national monuments to any other people. They form the outward and visible sign of the national existence and re-birth.[27]

Harrison's claims caused a stir. The *Nineteenth Century*'s then editor and founder of the 'Metaphysical Society', James Knowles, published a counter-response in the periodical's March 1891 issue. 'The Joke About the Elgin Marbles,' treated Harrison with measured irreverence, pretending his tongue had been firmly in his cheek all along.[28] Harrison's "little *jeu d'esprit*", Knowles claimed, "is a piece of political satire of a very striking character … so extravagant and comical … that it must have some other meaning than a literal one".[29]

In spite of his sarcastic dismissal, it is clear that Harrison's "perverted points of fact" struck a nerve with Knowles.[30] In fact, the suggestion that Harrison had "some other meaning than a literal one" is entirely the point. Harrison's language is intended to draw attention to what he believes are the metaphysical and numinous qualities of the stones. Harrison treats the marbles not merely as material objects, but as complex, living things that have been mutilated, stolen and reappropriated. Hence, describing the marbles in anthropomorphic terms, Harrison writes that "[t]hese demigods seem to pine and mope in the London murk: in their native sunlight, the fragments seem to breathe again".[31]

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[26] Harrison, 'Marbles', p. 985.
[27] Ibid., pp. 981–82.
[28] James Knowles, 'The Joke About the Elgin Marbles', *Nineteenth Century*, 29 (Mar 1891), 495–506.
[29] Ibid,. p. 495.
[30] Ibid., p. 503.
[31] Harrison, 'Marbles', p. 984.

Yet despite Harrison's focus on restitution and preservation, his essay is marked by absence—not simply the schism separating the marbles from the Parthenon, but more poignantly, the destruction of signification itself:

> When civilized man makes his pilgrimage to the Acropolis ... he marks the pediments which Lord Elgin wrecked and left a wreck stripped of their figures; he sees long bare slices of torn marble, whence the frieze was gutted out, and the sixteen holes where the two ambassadors wrenched out the Metopes. We English have wrung off and hold essential parts of a great national building, which beats wreckage on its mangled brow, and which, like Œdipus at Colonus, holds up to view the hollow orbs out of which we tore the very eyes of Pheidias.[32]

Knowles views this passage with particular distaste, the "obscurity" of its metaphor matched only by Harrison's "verbosity".[33] And he has a point. The metaphor is muddled—is Oedipus intended to stand for Lord Elgin or the Parthenon? In conjunction with the rest of the passage, the image contrasts with the carefully reasoned points throughout the rest of the article. Perhaps Harrison intended to evoke the idea of castration, represented through Oedipus' self-blinding; but even if this is the case, the association is tenuous. And if Lord Elgin's 'gutting' of the frieze is being construed as an act of imperial mutilation against another country, the important 'self' term of the Oedipal metaphor is still left unattached.

Harrison's language in this passage is anything but impartial. For Knowles, it is little more than demagogic "street rhetoric". In his rebuttal, Knowles singles out the terms he finds most offensive: "*wrecked* and *stripped* and *rent*, and *wrenched; bare slices; scars; torn marble; dreadful havoc; mangled brow; feeble groans*; and so forth [emphasis original]".[34] In spite of his dismissive tone, then, Knowles calls into question the value and ethical propriety of Harrison's discourse. Knowles' distrust of the qualitative and metaphoric dimensions of language, particularly its deployment as a form of coercive affect in an otherwise historical-political argument, suggests he

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[32] Ibid., p. 982.
[33] Knowles, 'Joke', p. 503.
[34] Ibid.

believes the real corruption of signification lies not with Elgin's treatment of the marbles but with Harrison's. The "cynical" and "false assertion[s]" propagated by Harrison the "mob-orator" corrupt both his "final point and moral" and the true historical complexity of the marbles' acquisition. [35]

Thus, whilst Harrison sees the stones as material objects that are part of a larger temporal circuit, Knowles argues that their status as artefacts remains constant in spite of their relocation. "As a matter of fact", he writes,

> no perceptible change has taken place in all that time; but, even to the most minute particulars, the original marbles of those two mighty figures [Theseus and Ilissus] remain, line for line and atom for atom[36]

For Knowles, the marbles' material constancy extends beyond perceptible changes in their composition. Even at the atomic level, the stones remain fixed. Housed within the safe confines of the British Museum, they stand apart from time, resisting material decay and preserved with the utmost care in a hall "especially constructed for their reception".[37] This, according to Knowles, is the appropriate way to view historical objects: arranged in an open and light space so the full artistry of their form can be appreciated. Harrison's article ignores the benefits of public curation. But his language, Knowles also believes, corrupts the marbles, imposing on them qualities that are not real and contorting historical complexity into a simplistic fantasy. Thus, according to Knowles the British Museum's stewardship of the marbles is successful on two fronts. Being "hermetically sealed under plate glass" protects the stones' material form while their arrangement in light, open, public space allows for maximum public exposure. "[P]roperly raised upon pedestals above the level of the eye," the marbles' storage in

[35] Ibid., p. 504.
[36] Ibid., p. 502.
[37] Ibid., p. 501.

specially ordered space allows them to "be seen, and studied, and admired at leisure and at ease from every point of view".[38]

Implicit here is the suggestion that careful, objective and considered reflection of an object is connected to the ability to observe and study it. With the marbles elevated on pedestals and visible from multiple angles, knowledge of their qualities necessarily follows. Such a sentiment would in fact seem to echo the positivist epistemology of Auguste Comte and Harrison: a unified system of knowledge that sought scientifically to regulate empirical data. Harrison was one of Victorian Britain's foremost Comtists, translating Comte's work and championing his ideals in the periodical press. Although they shared ideals, the two men met only briefly in Paris, two years before Comte's death in 1857. Yet galvanised "by the heroic labours" involved in the production of Comte's four-volume *System of Positive Polity* (1851-1854), Harrison left Paris to study law alongside positivism.[39] He later co-founded and regularly contributed to the *Positivist Review* and was the English Positivist Committee's president from 1880 to 1905. Unquestionably, Harrison was an ardent supporter of Comte and much of his life was devoted to spreading the positivist message.

Comte's positivism held that a true knowledge of the world was derived from the unification of sense data and scientific observation. It was predicated on Newton's notion of action and reaction, where the "depiction of stable forces at equilibrium between opposing forces" remains constant.[40] While the proper object of scientific study was for Comte the measurable, he also believed that the separate disciplines of science should form a single "comprehensive system" whose purpose would be the

[38] Ibid.
[39] Martha S. Vogeler, 'Introduction' in Frederic Harrison, *Order and Progress* (Cranbury: Associated University Presses, 1975), p. viii.
[40] Aviezer Tucker, 'Sciences of Historical Tokens and Theoretical Types: History and the Social Sciences' in *The Oxford Handbook of Philosophy of Science*, ed. Harold Kincaid (Oxford: Oxford University Press, 2012), pp. 274–97 (p. 276).

overall improvement of society.[41] Armed with facts, the diligent positivist could set about working towards a better future. As Comte explained: "[a]ll good intellects have repeated … that there can be no real knowledge but that which is based on observed facts".[42] Subsequently, the foundation of a universal epistemology is contingent on the ability of people to measure, classify and simplify and improve. Science should not be concerned with the speculative or inferential, but rather, the present concerns most detrimental to society at a given time. As such, Comte distils the knowledge claims a person can make into a simple binary: "[o]ne refers to the objects of sense and … is a scientific statement", summarises Daniel Robinson. "The other is nonsense".[43] For Comte "the science of society", thus provided "the only logical and scientific link by which all our varied observations can be brought into one consistent whole".[44]

This sketch of Comtean positivism is, while accurate, nonetheless slightly reductive. But Harrison claimed his critics were guilty of promulgating totally misinformed and wildly obnoxious caricatures of positivism:

> According to some … it means only the 'paralysing and iron rule of law.' With some, it is the concentration of all human energy on self; with others, an [sic] Utopia which is to eliminate self from human nature.[45]

In their discussion of the marbles' preservation, Harrison and Knowles thus trade caricatured positions. Knowles is the stereotypical positivist as imagined by its critics: concerned only with empirical facts and measurable quantities. Maintaining that the statues are no different from other artefacts, Knowles sees them as operating in a simple closed circuit, consisting solely of their extension in space. They are objects to be looked upon by the subject and whose meaning remains consistent regardless of

[41] *Auguste Comte and Positivism: The Essential Writings*, ed., Gertrude Lenzer (Piscataway, NJ: Harper and Row, 2009), p. 317
[42] Auguste Comte, *The Positivist Philosophy of Auguste Comte*, trans. Harriet Martineau, 2 vols (London: John Chapman, 1853), I, p. 3.
[43] Daniel N. Robinson, *An Intellectual History of Psychology*, 3rd edn (Madison and London: University of Wisconsin Press, 1995), p. 269.
[44] *Auguste Comte and* Positivism, p. 317
[45] Frederic Harrison, 'The Positivist Problem', *Fortnightly Review*, 12 (1869), 469-93 (p. 470).

their context. In spite of his own interest in metaphysics, Knowles rejects Harrison's belief that the marbles have intensive qualities in excess of their physical form. This is curious. Knowles' opposition to "scientific materialism" was predicated on his belief that metaphysical enquiry was essential to a true understanding of the world.[46] In fact the foundation of the Metaphysical Society in 1869 originated in a conversation at Knowles' house between guests (among them Tennyson and James Martineau) committed to a shared theological remit, "the main object of which should be the submitting to searching criticism the intellectual foundations of the spreading Positivism and Agnosticism".[47] Knowles, then, was certainly no friend of positivism or barren empiricism. But his distrust of metaphorical language and his contention that the Parthenon stones are no more than simple objects belies his own reductive inclinations.

Harrison, meanwhile, also resists caricature, despite the consensus arrived at by many of his contemporaries. "Mr. Frederic Harrison", wrote W. S Lilly in the *Fortnightly Review*, disregards as inconsequential and false, "everything which the senses cannot verify; everything beyond the bounds of physical science; everything which cannot be brought into a laboratory and dealt with chemically".[48] This is remarkably inaccurate. Harrison was of course a positivist—and an ardent supporter of Comtean positivism in particular. Yet he was also profoundly concerned with locating ethical coordinates in a changing material world: a world that, for Harrison, has numinous, emotional and moral dimensions. In fact, Harrison argues, any form of materialist doctrine that "has nothing to say about the spiritual life … has no particular

[46] James Knowles, as quoted in Alan Willard Brown, *The Metaphysical Society: Victorian Minds in Crisis, 1869–1880* (New York: Columbia University Press, 1947), p. 21.
[47] James Martineau, *The Life and Letters of James Martineau*, eds. James Drummond and Charles Barnes Upton, 2 vols (London: J. Nisbit and Company, 1902), II, p. 368
[48] W. S. Lilly, 'Materialism and Morality', in *Fortnightly Review*, 40 (1886), 575–94 (p. 578). For other late nineteenth- and early twentieth-century characterisations of Harrison as a reductive materialist see Mary W. Calkins, *The Persistent Problems of Philosophy: An Introduction to Metaphysics* (Norwood: The Macmillan Company, 1907); Anon. 'The Ethical Aspects of Materialism', *The Saturday Review*, 62 (1886), 651–52; William Barry, 'Science and Religion', *The Contemporary Review*, 46 (1884), 397–413.

religion [and] ignores the Soul", is a "materialism to fear".[49] Like Tyndall, Harrison is a materialist, but not a determinist or reductionist. His positivism is an "ethical enterprise" which maintains that the *type* of relationship between material objects and humans has a powerful effect on the cultural, national and metaphysical traces of the past. Such concerns extend to Harrison's quest for a moral epistemology of things; an epistemology where language's poetic potential responds to the material world in a manner that is at once creative and true. Yet it also encompasses the notion of failure, the breaks in epistemological circuits between object and man, matter and mind. Thus, as we shall see, the very *incongruity* of the Oedipal metaphor earlier criticised by Knowles, is essential to Harrison's ethical response to the marbles and the status of his own work in constructing a material trace of the past.

Productively, John Kucich also reads Victorian positivism against the grain. He suggests that counter to nineteenth-century criticisms, many positivists were not especially interested in the rational presentation of objective facts. Rather, they were concerned with the deeper truths "link[ing] phenomena together beneath the level of appearances."[50] This phrase, "beneath the level of appearances", is essential to teasing out some of the more complex suggestions in Harrison's article and the function of the seemingly incongruous Oedipal metaphor. We already know that Harrison sees the marbles in more than purely material terms. They exist, for him, as both valuable objects and as repositories of stored memory. Their form, in other words, is part spatial, part temporal, their *incorporeal* (but not immaterial) 'thingness' necessarily predicated on their material extension. Yet, their ability to resonate, to convey 'the weird message from the past' is corrupted with their removal from the Parthenon.

Metaphor works in a similar way. Tracing the problematic implications of contemporary cultural theory obsessed with using prosthetics, biomechanics, and implants as metaphors for "post-human" utopian freedom, Vivian Sobchack writes:

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[49] Frederic Harrison, 'The Soul and Future Life' *Nineteenth Century*, 1 (1877), 832–42 (p. 842).
[50] John Kucich, 'Intellectual debate in the Victorian novel: religion and science' in *The Cambridge Companion to the Victorian Novel*, ed. Deirdre David, 2nd edn (Cambridge and New York: Cambridge University Press, 2001), pp. 107–28 (p. 116).

the metaphor ... is often less expansive than it is reductive, and its figuration is less complex and dynamic in aspect and function than the object and relations from whence it was–dare I say it–amputated.[51]

In other words, Sobchack cautions that the metaphorical mode of displacement, its substitution of one term for another, is often at the expense of the original idea's complexity. Moreover, her use of the term "amputated" resonates with the Harrison's use of the semantics of mutilation and the function of, as we shall see, his confused Oedipal metaphor. Sobchack is herself an amputee after losing her leg to cancer. She was furious with Jean Baudrillard for what she claimed was his pathologically stupid suggestion that the violent fusion of human bodies and machines (as in car crashes) is inherently sexual. For Sobchack, critics who use biomechanical metaphors to create narratives of potential, bodily divergence and phenomenological emancipation obscure the ambivalent, often tortuous experiences faced by people actually reliant on nonhuman prosthetics. Sobchack writes that having her 'real' leg replaced by a prosthetic limb was immensely traumatic: it 'stood' as a literal embodiment of loss. Over time, Sobchack adapted to the new limb, a doubled symbol of both intangible presence and tangible absence. The amputated leg on its own is worthless to her, an inanimate lump of matter. It is, paradoxically, only in its connection to the body as a whole that its individual qualities as a leg are realised. The same is true of metaphor, Sobchack argues. 'Amputating' the part from a wider circuit often reduces the 'thing' that made the individual component unique in the first instance.

Transposing these ideas to Harrison's article, a strange paradox emerges. Harrison makes it plain that Lord Elgin has similarly 'amputated' the marbles; an act visible to every Athenian who raises their eyes to the Parthenon and sees "the scars

[51] Vivian Sobchack, 'A Leg to Stand On' in *The Prosthetic Impulse: From a Posthuman Present to a Biocultural Future*, eds. Marquard Smith and Joanne Morra (Cambridge, MA: MIT Press, 2006), pp. 17-41 (p. 21).

where … a rich Englishman wrenched off slices of the building".[52] Yet, we have also seen Harrison's muddled Oedipus metaphor fail, with Knowles convinced that Harrison's own language is corrupting the 'real' story of the stones. Regardless of its initial intention, I propose a third reading that views the Oedipal metaphor as both working and not working, predicated on the dynamic but ambivalent coupling of intangible presence and tangible absence. Oedipus' self-blinding symbolises not only self-castration or tormented guilt. It also stands as a complex paradox concerning his ability to interpret the symbolic. Prior to discovering his patricide and incest, Oedipus boasts of his skill in decoding signs, taunting the blind Tiresias and accusing him of promulgating falsehoods.[53] But upon learning of his true identity and his inability to recognise the signs essential to the original prophecy regarding his future, Oedipus blinds himself. The act is frustratingly contradictory. It is both a sign and not a sign. In blinding himself, Oedipus rejects the world of sensory sight for that of the symbolic, yet concurrently creates a sign that he cannot see—the fulfilment of Tiresias' prophecy.

Paul Ricoeur notes that the moment of Oedipal blinding thus produces a conflict of meaning by creating *and* filling a lacuna in the text: "[e]xternal destiny has been internalized" and "hidden" within the Oedipal body; yet it simultaneously forms a visible external marker of history that links it to the symbolic 'outside'.[54] The sign's circuitry is both closed and open. It flits between the two states, never settling fully on one condition. Intentionally or not, Harrison's Oedipal metaphor, in conjunction with the semantics of mutilation, works in the same way. And it is this predication on the presence/absence, is/is not compound, which ultimately marks his article as a textual testament to *failed* transmission. To extrapolate this idea further: the 'obtuse' Oedipal metaphor is undeniably muddled. Its structure is confusing and there are too many terms that are potentially interchangeable: *the English, Oedipus, the sculptor Pheidias,*

[52] Harrison, 'Marbles', p. 983.
[53] John T. Kirby, *Secrets of the Muses Retold: Influences on Italian Authors of the Twentieth Century* (Chicago: University of Chicago Press, 2000) p. 12.
[54] Paul Ricoeur, 'Consciousness and the Unconscious', trans. Willis Domingo in *The Conflict of Interpretations*, ed. Don Ihde (London: Continuum, 2004), 97–118 (p. 114)

hollow orbs, eyes, the Parthenon's frieze. And even though there is a general sense of metaphorical resemblance between Oedipus and the damage done to the Parthenon—mutilation to the body, the interplay of signification beyond the materially visible—it reads as a careless association built primarily around the shared quality of 'ancient Greek-ness'. This is probably the truth of the matter. But it is also inconsequential. Regardless of Harrison's initial intention, the formal and conceptual plasticity of his words allows them to be moulded by extra-textual forces.

Harrison throughout his article emphasises the stones as belonging to a particular circuit of signification, nodal points in a complex network whose individual meaning is only fully realised through their relationship to the whole. However, in line with his view that the past has been wounded by imperialist acts, he constructs a circuit between the stones and his text that is significant *because* of its failure to connect. The metaphor begins to work (it gestures towards a general notion of harm being inflicted upon signification) only to fail as we stumble over its clumsy construction. The metaphoric link conjoining subject and predicate is unstable. Although each subject is connected to a corresponding predicate—"We English" / "wrung off and hold"; "building" / "beats wreckage on its … brow; "Oedipus" / "holds up to view the hollow orbs … of Pheidias"—the clauses taken together produce a dead-ended circuit. As a consequence, the bridge between Harrison's metaphor and the marbles' thingness is itself tenuous. They are linked: yet the current of meaning flowing between them is insufficient to power an image rich in conceptual clarity. Here then, the text itself embodies the damage done to the stones. It too is marked by wounds and missing parts that prevent linguistic meaning from cohering. It provides a space of conceptual absence, a lacuna of metaphoric substitution Oedipally incestuous in its circuitry. Meaning, in short, struggles to emerge. Harrison's language gestures toward the stones, only for its signifying loop to close back in on the text in a cycle of repetitive presence and absence.

There is a further implication that must be considered: how does the failure of meaning relate to the literary periodical as a material object itself moving through time? Virginia Zimmerman notes that *Nineteenth Century* was created to reflect and respond to the changing zeitgeist, and thus "became a trace that preserves its [own] time".[55] Certainly, the title of the periodical was carefully chosen by Knowles to evoke a sense of both the retrospective and the contemporaneous. And its subsequent name changes, *The Nineteenth Century and After* in 1901 and *The Twentieth Century* in 1951, further belie an impulse to, in Harrison's words, look backwards and forwards at the same time. The periodical-as-object thus retains a curious relation to time and space and wider circulatory media. On one hand, it remains elusive, due in part to its inherent ephemerality. Efforts to preserve its own 'time', to act as a material trace of nineteenth-century thought, are undermined by the conditions of its publication. Released in monthly instalments the materials comprising the magazine and the matters discussed were circulated, read and then replaced. The contents of old issues, though catalogued and numbered, would be unlikely to remain in readers' minds for very long. And the materials used in the construction of periodicals were themselves subject to degradation if not carefully preserved, the chemical composition of the paper almost guaranteeing its fragility.[56] Therefore, the cyclical and repetitive time of renewed publication sits uneasily alongside the tendency of things to decay linearly.

On the other hand, however, this mode of publication simultaneously ensured it kept pace with the spirit of the age, categorising whole sections of time at fixed, regular points. As Zimmerman notes, periodicals are both of a culture and at the same time, "provide a survey of that culture's concerns" by recording and condensing an assortment of topics.[57] Moreover, the paper-matter of the *Nineteenth Century* was of a notably higher quality than the weeklies and dailies. The quality of the materials used in its production ensured it was not subject to the same degree of degradation as paper

[55] Zimmerman, 'Message', p. 119.
[56] Ibid., p. 128.
[57] Ibid., p. 119.

used by cheaper, flimsier journals. By the turn of the century, the highbrow monthly reviews typically averaged 150 to 200 pages in length, were printed on thick 9-by-6-inch paper and cost nearly five times more than the popular *Strand* magazine.[58] The high price of the periodical thus also made "the common reader dependent on lending and circulation schemes".[59] Being passed among numerous readers was thus in keeping with the *Nineteenth's Century*'s dedication to a symposium style open forum, where a topic would be debated dialogically between a variety of contributors over a number of months. A single issue could be used and reused many times over, remaining in private circulation long after it had ceased to be sold in public. The *Nineteenth Century* as material object was thus never really an isolated, self-contained work. It gestured outside of itself to wider networks comprised of multiple writers, readers, topics and recirculation.

Accordingly, this open and relational network of communication functions in line with Harrison's desire to creating lasting material traces of social thought, "treasured up as a sacred deposit for the instruction of our distant descendants".[60] His 'Marbles' article, however, retains a conflicted connection to this network. It is, crucially, *amputated* from a larger contextual whole. For one, Knowles' reply to Harrison was the last word in the 'debate'. It was intended to finalise the matter and Knowles subsequently exercised his editorial control by refusing Harrison a counter-response. Moreover, the article itself remains eerily unhinged to the marbles. It is not fully separate from them, yet the conceptual links tying Harrison's language and the marbles' thingness is broken and scarred.

Poems, artefacts or places, suggests Harrison, "are, each and all, like a great life, or a memorable deed": an event in time that "can never be repeated in the same way

[58] Mark Morrisson, *The Public Face of Modernism: Little Magazines, Audiences, and Reception 1905–1920* (Wisconsin: University of Wisconsin Press, 2001), p. 43.
[59] *Dictionary of Nineteenth-Century Journalism*, p. 516.
[60] Harrison, *Pompeii*, p. 383.

again".[61] This, in a sentence, is Harrison's ethical point. A collection of unique objects, wrenched from their original material and temporal contexts and displayed anatomically in hermetically sealed cases, cannot repeat at all. The past does not appear differentially, nor do the objects function as a resonant note in a larger symphony. Harrison's article thus memorialises the marbles by appropriating their *inability* to resonate with the message of the past. In full accordance with his positivist beliefs geared towards creating an ethical epistemology, the article fossilises a moment in time. It looks to the past in its analysis of the marbles yet also looks forward to a future where they might be returned to the Parthenon. In its failure fully to connect with the thingness or objectile qualities of the marbles his article thus perpetually re-enacts their *current* (that is, their circumstances in 1890) inability to mean. While hoping for their reunification, Harrison creates a lasting memory for future readers who might live in an age where the stones have been returned to the Acropolis. Thus, in line with his perusal of an ethical philosophy of human/non-human interactions, he preserves for future generations a trace that memorialises a time when the stones were unable to mean. Yet, where Harrison's article creates a circuit that works because of its failure, objects themselves also have the ability to resist coercion. As we shall see, in evolutionary exhibitions supposedly dead objects returned to life to haunt curators intent on using them to embody ideological narratives of progress.

5.2 Dead matter / living time

In *Pasts Beyond Memory*, Tony Bennett links the changing practices of museum curation in nineteenth-century Europe to emergent principles in natural history, new liberalism and epistemological formulations of the self and time. Organised under the schema of Darwinian evolution, the previously separated historical sciences formed a coalition that sought to render visible the past that lay beyond memory by arranging

[61] Frederic Harrison, 'The Sacredness of Ancient Buildings', *The Contemporary Review*, 52 (1887), 55–67 (p. 55).

fossils to form an unbroken temporal narrative.[62] In museums such as Le Muséum National d'Histoire Naturelle, the material remnants of evolution adopted a metonymic function as their status as individual specimens was subtended in favour of their temporal relations to other objects in the collection. These 'dead' things—fossils, bones, preserved carcasses, petrified plants—were arranged in displays that recognised the deep geological time spanning millions of years. Each constituent relic was seen to provide a trace of the past's endurance in the present: material moments in continuous, linear time. "No longer significant for their uniqueness", writes Lara Kriegel,

> objects became meaningful for their ability to represent stages of development. They took on the burden of exhibiting the imperceptibly long process of evolution, which was invisible to the naked eye.[63]

Objects in evolutionary exhibitions hence formed a spatial narrative of time, representing vast evolutionary changes through their resulting forms. Steven Conn understands this impulse in essentially constructive terms. Objects were used to create narratives of self by allowing Victorians to locate themselves at the end of a long line of natural adaptations. Yet, as Bennett notes, such object-based epistemologies also contained a tyrannical undercurrent. Museum curators had absolute authority over their collection, turning the "museum into the site of a monologic discourse", where the public's position was limited to passive spectator.[64] Just as the Parthenon marbles were hermetically sealed in glass cases, ordered and separated in space to be viewed from all angles, so too were the fossils in evolutionary exhibitions spatially regulated. For 'evolutionary showmen' such as William Henry Flower, the neat arrangement of objects in divided space formed the cornerstone of a rational epistemology. It exposed the public to evolutionary evidence while documenting the progress of mankind: from the

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[62] Tony Bennett, *Pasts Beyond Memory: Evolution, Museums, Colonialism*, (Routledge: London and New York, 2004), p. 22.
[63] Lara Kriegel, 'After the Exhibition Complex: Museum Histories and the Future of the Victorian Past', *Victorian Studies,* 48:4 (2006), 681–704 (p. 686).
[64] Bennett, *Pasts*, p. 14.

simplest Chordates through to more complex life forms, primitive early humans and finally, civilised man.

Flower was appointed director of the Natural History department of the British Museum in South Kensington, after the retirement of Richard Owen in 1884, and quickly implemented his methodology. Building on the work of scientific popularisers such as John George Wood, Flower believed the taxonomy of fossils required them to be systematically ordered, classified and grouped. A careful curator of the evolutionary exhibition, he wrote in 1898, will do the following:

> He will … divide the subject to be illustrated into groups, and consider their relative proportions, according to which he will plan out the space. … [E]volution of the subjects to be dealt with, will be laid down and reduced to definite and concise language. Lastly will come the illustrative specimens, each of which as procured and prepared will fall into its appropriate place.[65]

In Flower's view, the logical temporal contiguity of specimens would naturally follow their arrangement in planned space, regardless of their actual correlation (or lack thereof) to one another. For example, body parts, organs and bones from different animal species would be grouped together to show their comparative likenesses. Moreover, Flower revolutionised educational standards of public museums by calling for the use of clear, concise language. He was among the first curators to label specimens, defining their particular place in evolutionary history. With these elements combined, Flower believed the cataloguing of specimens would create a visual topography of the past, simple and accessible to the general public.

In the same year that Flower was granted directorship of the Natural History department, Augustus Pitt Rivers donated his collection of anthropological, ethnographical and archaeological objects to the University of Oxford. The rationale behind the arrangement of the Pitt Rivers collection was similar to Flower's. Grounded

[65] William Henry Flower, *Essays on Museums and Other Subjects Connected with Natural History* (London: Macmillan, 1898), p. 18.

upon both a teleological vision of progress and anthropological superiority, Pitt Rivers' exhibition proposed to "trace all mankind back to a single source and to reconstruct the history of human racial differentiation and interconnection".[66] Rather than grouping artefacts according to specific culture or country, objects were arranged by general 'type'. For example, 'primitive' tools used by humans from all over the world were grouped together in the service of showing how supposedly savage cultures become progressively more sophisticated.

Organised under the typological method, specimens were arranged to further an ideological vision of progress by removing them from their habitual context. Moreover, the exhibition propounded a barely-codified vision of human hierarchy based on racial difference. In the Pitt Rivers collection and other natural history museums, "the notion of Africa as evolutionary relic was produced, authorised, and reinforced".[67] In the Pitt Rivers and Natural History museums, fossils, animals and objects were thus used to construct ideological evolutionary narratives. Nature's organic past was primitive but successive adaptions had yielded more complex life forms. The spatial positioning of these objects was particularly important. Separation could imply difference while grouping could draw attention to comparative similarities across species, races and cultures. Time was converted into spatial coordinates and divided into segments to demonstrate linear progress as the individual complexity of objects yielded to the curator's idealistic narrative. Yet, returning to Flower's comments describing curatorial practices, there is a telling caveat regarding the separation of specimens in space: "As it is not always easy to obtain these at the time that they are wanted, gaps will often have to be left".[68] It is because of these gaps—missing links in the fossil record, for example—and the insistence on viewing objects in terms of forced relations in an imposed circuit,

[66] William Ryan Chapman, 'Arranging Ethnology: A. H. L. F. Pitt Rivers and the Typological Tradition', in *Objects and Others: Essays on Museums and Material Culture*, ed. George W. Stocking, Jr. (Madison: University of Wisconsin Press, 1985), pp. 15–48 (p. 39).
[67] Monique Scott, *Rethinking Evolution in the Museum: envisioning African origins* (Abingdon and New York: Routledge, 2007), p. 29.
[68] Flower, *Museums*, p. 18.

that the evolutionary showmen's attempts to create a visual cartography of time were not as coherent as they liked to believe.

While natural history collections seemed to provide a new grammar of temporality that understood the past as layered, sedimented and teleological, the 'gaps' produced by missing links deconstructed the evolutionary exhibitionists' narratives.[69] Evolution is, by definition, a gradual process whereby organisms evolve through the aggregate effect of a multitude of tiny, imperceptible changes. These morphogenetic qualities cannot be seen directly; they can only be seen indirectly through their material outcomes.[70] Failing fully to understand this distinction, the curators of evolutionary exhibitions were unable to recognise that attempts to use discrete or decontextualized objects to suggest continuous time was impossible. As we saw in the previous chapter, Bergson's distinction between quantitative (spatial) multiplicities and qualitative (durational) multiplicities conceptualises why these exhibitions resisted a teleological narrative. In these museums, the past could only be quantitatively suggested by the spatial ordering of fossils. The gaps that divided specimens—both the physical spaces in the display and the evolutionary spaces between, for example, pre-Cambrian and Cambrian forms—disrupted morphologists' attempts to trace a continuous, unbroken lineage. Each missing link pointed towards the intensive organic processes driving evolutionary adaptations. But because these processes were impossible to represent with individual objects located in ordered space, they undermined the evolutionists' narratives of progress.

Darwin himself was aware that imperfections in the fossil record undermined attempts to construct a visual cartography of time. He noted that as the earth's surface is rewritten by large-scale geological events, evidence of evolution deposited in its crust is erased. If the earth is itself an unreliable storage system, then the efforts of evolutionary curators are contrived:

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[69] Kriegel, 'Exhibition Complex', p. 685
[70] Bennett, *Pasts*, p. 161.

The number of specimens in all our museums is absolutely as nothing as compared with the countless generations of countless species which certainly have existed. We should not be able to recognise a species as the parent of any one or more species if we were to examine them ever so closely, unless we likewise possessed many of the intermediate links between their past or present and parent states; and these many links we could hardly ever expect to discover, owing to the imperfection of the geological record.[71]

Even possession of the 'intermediate links' would not be enough: for as Bergson suggests, duration cannot be broken into discrete units.

With this in mind, we can discern two types of voids that arise from attempts to subjugate matter and frame my reading of James' texts. The first voids are those representing the triumph of the subject over matter, as things are reduced to mere objects. Divorced from the historical, cultural and material contexts, the past appears not as something irreducibly complex but fails to appear at all. It is, in short, replaced by *no thingness*. This is what Harrison suggests has been inflicted upon the Parthenon marbles. When Elgin physically mutilated them he also wounded their temporal connection to the past, erasing their origin to the extent that they now bear *his* name—the Elgin Marbles. The second voids are those that formed between links in the evolutionary exhibition. These blind spots destabilised attempts by the evolutionary showmen to possess the past, by introducing discontinuity into their temporal narratives. Despite their deconstructive effect, these spaces signified pure duration by pointing to processes that lay outside direct human observation. In James' texts, both types of void proliferate. Characters wound the temporal qualities of objects by using them to construct narratives of self. But the past also refuses to obey their commands. As in evolutionary museums, the pure duration of the past returns unexpectedly to destabilise, haunt and even possess the present.

[71] Darwin, *Origin*, p. 382.

5.3 Objectified subjects and subjectified objects

The eponymous heroine of James' *What Maisie Knew* (1897) is delighted when her former governess and stepmother, Mrs Beale, suggests they visit "'the thingumbob at Earl's Court'".[72] Exotic and raucous, the "great Exhibition" is a middle class pantheon of late nineteenth-century spectacle: a space overflowing with a "collection of extraordinary foreign things … illuminations, bands, elephants, switchbacks and sideshows".[73] As Maisie and Mrs Beale wander through the hall their attention is diverted by an "enthralling" sideshow—"the Flowers of the Forest," featuring "a large presentment of bright brown ladies … in a medium suggestive of tropical luxuriance." But the feeling of wonder is fleeting. Soon, the show takes for Maisie "a very different turn indeed." Emerging from the hubbub of the crowd appears a lady "so brown" Maisie mistakes her "for one of the Flowers." After a moment's confusion it becomes clear that this woman is in attendance with Maisie's father. The ensuing public revelation of Mr Farange's "brand-new one" unleashes a torrent of repressed tension and a violent shift in "[t]he act of possession" as Maisie finds herself at the centre "of a livelier battle than had ever … been waged around" her.[74] Surrounded by the exhibition's regulated but curiously disposed thingumbobs, Maisie, without having time to comprehend what has happened, is grabbed by her father and marched from the hall. An object frivolously passed between irresponsible parents and guardians, Maisie becomes the property of another. In an instant, the "wondrous" object-filled space of the exhibition is transformed into "a rattling void filled with relinquished step-parents."[75]

James was himself an avid visitor of exhibitions—artistic, historical and scientific. He would often meet with William Morris, John Ruskin and Edward Burne-

[72] Henry James, *What Maisie Knew* (Oxford: Oxford University Press, 2008), p. 119.
[73] Ibid.
[74] Ibid., p. 122; 124.
[75] Ibid., p. 125; 126.

Jones to peruse displays at the British Museum and discuss current events.[76] Fascinated by spectacle and material excess, these spaces had, as Tamara Follini argues, an "immense influence" on James' work. They contributed not only to the "growth of his aesthetic understanding" but functioned for him as areas "of contested ground or incompatibility."[77] In James' texts, collections of objects repeatedly act as sites of aberrant power where dark impulses and violent energies lurk beneath the façade of arranged social, economic and material order. They are spaces in which boundaries between subject and object blur, as humans, things and time struggle for possession over one another. Having an acutely delicate aesthetic sensibility, James, Follini argues, was all too aware of the "fearsome power of 'Acquisition'"—of how "the economic and egotistical forces" of curation could debase works of art.[78]

But James was also aware of the threat that objects posed to human subjectivity. Writing in 1865, he describes the "overwhelming" anxiety felt when encountering "the monstrous birds, beasts, and reptiles which desolated the earth previous to man's advent, and whose fossil remains we shudder over in our scientific museums."[79] These 'dead' things had a strange power to induce epistemological anguish. Although James ultimately felt assured that humans had an innate moral force that distinguished them from baser creatures, these monstrous specimens still prompted him to question the "difference between human nature and all lower natures."[80] In James' texts, pasts where human agency is incapacitated or non-existent come back to haunt the present. Both people *and* objects have for James the capacity for debasement and possession. And across the pages of *The Spoils of Poynton* and *The*

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[76] Leon Edel, *Henry James: A Life*, (London: Collins, 1985), p. 166; Jennifer Eimers, 'A Brief Biography of Henry James' in *A Companion to Henry James*, ed. Greg W. Zacharias (Chichester: Blackwell, 2008), pp. 277–91 (p. 281).
[77] Tamara L. Follini, 'Museums and exhibitions' in *Henry James in Context*, ed. David McWhirter (Cambridge and New York: Cambridge University Press, 2010), pp. 234–45 (p. 236; 239).
[78] Ibid., p. 235.
[79] Henry James, 'Faith and Science', *The North American Review*, 101 (1865), 335–78 (p. 365).
[80] Ibid., p. 366.

Turn of the Screw, we see these tensions play out in ever-more disturbing ways as people, objects and time fail to find equilibrium.

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The Spoils of Poynton concerns a war of attrition over the possession of a vast collection of objects—furniture, paintings, sculptures, books, heirlooms, jewellery, tapestries, and so on. Mrs Adela Gereth has amassed these artefacts over the course of a lifetime, combining them with her home, Poynton, to form a "single splendid object".[81]Their value to her is immense; they are an extension of her self. However, with the death of Mrs Gereth's husband, the law of primogeniture decrees that the house and its contents must pass into the possession of her son, Owen (his name evoking the verb to 'own'). The conflict that arises is partly the result of this "ugly English custom" but also Owen's decision to marry Mona Brigstock: a woman who, Mrs Gereth feels, has no aesthetic appreciation of the objects she stands to possess.[82] In Fleda Vetch, Mrs Gereth finds a fellow soul apparently sympathetic to her artistic vision and who appreciates the objects' worth. As the narrative progresses, however, it becomes apparent the older lady has an ulterior motive for her friendship with Fleda. Concerned that Mona will replace Poynton's objects with "'pieces answerable to some vulgar modern notion of the 'handy'", she fears the destruction of the material traces of her subjectivity (12). In response, Mrs Gereth sees Fleda as her sole chance of keeping her past self alive in the present: "'*You* would replace me,'" she tells her (21). In advertising Fleda to Owen as a substitute wife, Mrs Gereth reveals her intention that Fleda will provide a dual purpose. The first will be to serve as Owen's marital object, while the second will be to safeguard Poynton's objects—and by extension, Mrs Gereth's materialised subjectivity—from harm.

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[81] Henry James, *The Spoils of Poynton* (Harmondsworth: Penguin Books, 1963), p. 9. Unless otherwise noted, all further references will be to this edition with page numbers parenthesised within the main text.
[82] Henry James, 'Preface to *The Spoils of Poynton*' in *The Art of the Novel: Critical Prefaces*, (London and New York: Charles Scribner's Sons, 1962), p. 120.

Before the betrothal of Owen and Mona is finalised, Mrs Gereth removes the objects to an intermediary house, 'Ricks'. This house is stripped of all traces of its previous owner, those things cast aside. Fleda is immensely troubled by the situation. She imagines the forthcoming removal of both houses' objects as a scene "somehow, of indignity and misery, of wounds inflicted and received" (37). The violence of her prediction is realised when Mrs Gereth figures her own ousting from Poynton in terms of physical mutilation:

> [H]aving passed the threshold of Poynton for the last time, the amputation, as she called it, had been performed. Her leg had come off—she had now begun to stump along with the lovely wooden substitute; she would stump for life (46).

The hyperbole of the analogy, though in accordance with Mrs Gereth's character, nonetheless points to the violent threat of dispossession that occurs when using objects to create narratives of the self. And in spite the comical image it conjures, the metaphor resonates with the language used by Harrison and Sobchack to describe the mutilation of meaning and the conflicted production of tangible absence and intangible presence. In Harrison's article, it is the stones' past, their objectile function, which has been desecrated. Here, however, it is the circuit linking Mrs Gereth's own subjectivity to the objects that suffers. Her self-pitying account of the move is thus put into stark relief by Fleda's focus not on the wounds inflicted on the older lady but the objects themselves. Passing the "threshold" of the replacement home for the first time since Mrs Gereth's 'transportation' of the things, Fleda's "instant perception" is that the place has been "dressed at the expense of Poynton". As such, the presence of the transplanted spoils prompts only thoughts of "great gaps in the other house" (47).

Given time to familiarise herself with the new home, Fleda's "dissimulated dread" becomes all the more pronounced: "what … the full picture most showed her was the far-away empty sockets, a scandal of nakedness between high bleak walls" (48). The language here evokes images of death and isolation: "empty sockets" suggesting a rotting skull and "nakedness between high bleak walls" an abused body confined in a cell. Yet it is also reminiscent of Harrison's Oedipal metaphor, whereby the 'fullness' of the picture is conspicuous by its absence as Oedipus gouges out his eyes to reveal gaping eye sockets. The suggestion is that Mrs Gereth has performed an act of evisceration against Poynton's objects and their relation to a wider circuit has been damaged. Once a "happy whole", they now "suffer like chopped limbs" (53).

Recalling Harrison's anthropomorphised marbles, the severed objects of Poynton thus stand not as monuments of preservation but extinction. Their replacement of the previous owners' objects are immensely destructive: "[t]he maiden aunt had been exterminated—no trace of her to tell her tale" (53). Of course, we know that this destruction of the past is by no means an isolated accident, having previously learnt, by her own admission, of Mrs Gereth's attempts to stop the objects relating to anyone but herself. As the image of amputation suggests, the spoils for Mrs Gereth are significant only in that they are an extension of her subjectivity, a "record" of her "life" (14). Yet in spite of generally presenting them as such, the objects amassed by Mrs Gereth are not solely hers. Her deceased husband had an equally important role to play in their collection. As Mrs Gereth tells Owen:

> The best things here, as you know, are the things your father and I collected, things that we worked for and waited for and suffered for. ... They were our religion, they were our life, they were *us*! (20)

According to this account, Poynton should be the record of two lives. Yet the use of the past tense of 'to be' ("were"), suggests this doubled relation no longer exists, and anticipates Mrs Gereth's following utterance: "now they're only *me*" (20). Mrs Gereth thus attempts, according to Fotois Sarris "to 'exterminate' her husband at Poynton the way she does the maiden-aunt at Ricks": by destroying any lingering trace of his role in collecting the objects.[83]

Moreover, though Mrs Gereth construes the present significance of the house and its things as entirely of her own making, Poynton's history stretches back hundreds of years. As Laurence Holland writes:

> [T]he rare objects in the Jacobean house (itself preserved for over two centuries) are old, and once were lodged in the hands of the Chinese, Florentines, Frenchman, Spaniards, and Maltese who originally made or possessed them.[84]

If "[n]o account whatever" is taken of Mrs Gereth's "relation to her treasures", then the same can be said of her attempt to stifle languages uttered by the objects in the "tongues of other countries" (16, 10). James shares Harrison's implication that the corruption of thingness is an imperialistic endeavour when he aligns Mrs Gereth with the colonial "discoverer", who arriving on foreign shores takes "possession of the fortunate island" (91). Like Lord Elgin, Mrs Gereth stifles the cultural histories still embedded within the objects, by placing them in a collection organised solely around herself.

Mrs Gereth's attempt to objectify her subjectivity by severing objects from their history is a response to number of threats: the law of primogeniture that ensures her dispossession; the threat posed by the power of laissez-faire economics, which collapsed distinctions between self and world and rendered individuals inseparable from their material worth, either as labourers or consumers; and finally, time itself, which, coupled with centennial anxiety and the encroachment of modernity, threatened to erase material traces of the past.[85] For Mrs Gereth, depositing her subjectivity in the

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[83] Fotois Sarris, 'Fetishism in *The Spoils of Poynton*', *Nineteenth Century Literature*, 51:1 (1996), 53–83 (p. 69).
[84] Laurence Bedwell Holland, *The Expense of Vision: Essays on the Craft of Henry James* (Princeton University Press: 1964), p. 92.
[85] Isobel Armstrong, *Victorian Poetry: Poetry, Poetics, and Politics*, (Routledge: London and New York, 1993), pp. 165–78.

objects and destroying their other pasts is the one defence she feels is able to counter these forces. As Baudrillard writes:

> Because he feels alienated and abolished by a social discourse whose rules escape him, the collector strives to reconstitute a discourse that is transparent to him, a discourse whose signifiers he controls and whose referent *par excellence* is himself.[86]

Mrs Gereth's attempt to externalise her own subjectivity and preserve her character beyond death can thus be seen as a response to such epistemological crises. Of course, Mrs Gereth, however intentional her actions, seems unaware of their implications: she is, by her own admission, a "rank bigot" (77). Yet Fleda, whose "subtle mind" (8) embraces "all the heights and depths and extremities of things" (92), is painfully aware that a metaphysical violence has been done to the objects:

> Fleda tried to think of some of the things at Poynton still unappropriated, but her memory was a blank about them, and in the effort to focus the old combinations she saw again nothing but gaps and scars, a vacancy that gathered at moments into something worse (54).

Whereas the gaps between fossils in the evolutionary museum attested to things' ability to deconstruct spatial narratives of time, the converse is true of Mrs Gereth's collection. The vacancy Fleda experiences is not irreducible intensity but rather, the lack of it: a loop that leads directly back to Mrs Gereth who is "herself the great piece in the gallery" (49). Thus, the "something worse" Fleda fears is the total lack of any pasts—only the continual, tyrannous present of Mrs Gereth's static Will, obliterating thingness at the expense of the grounded self.

And yet, though she is presented as domineering, hysterical and possessive, Mrs Gereth demands sympathy. She is a victim of patriarchal inheritance laws, her fate directly controlled by the men closest to her: the deceased Mr Gereth and her uninterested and weak son Owen. Mr Gereth, despite knowing how much the objects of

[86] Baudrillard, *Objects*, p. 114

Poynton meant to his wife, still decided to write a will founded upon the custom of primogeniture. Fleda is surprised at this insult and the incongruity between Mrs Gereth's favourable descriptions of her husband and the cruel reality of his actions. He had "apparently been a very amiable man, but Mr Gereth had left things in a way that made the girl marvel" (16). The "passion with which she [Mrs Gereth] had waited for" the spoils, thinks Fleda, "worked for them, picked them over, made them worthy of each other and the house,"—none of these things had been considered. Rather, Mr Gereth entrusts that "Owen's fairness" will "settle any questions" (17). While Mrs Gereth's actions are destructive and coercive, the reader only witnesses her actions *after* the death of her husband. This is a time of mourning for her yet she is unceremoniously uprooted from her environment. James elides her past—a past which spans decades and was structured around a mutually shared love of aesthetic beauty. And thus, by extension, James also conceals the true violence of the patriarchal forces inflicting injury upon Mrs Gereth, portraying her dispossession as a situation of her own making.

This perspective changes the entire complexion of Mrs Gereth's actions. Perhaps she has not destroyed the trace of her husband after all. Perhaps instead Mr Gereth has brought about the destruction of his wife, the decisions made in his will (a legal manifestation of his Will) haunting Mrs Gereth's present and future. He is an unseen, dead character. And yet it is his actions that have the greatest effect on everyone else in the novel, the root cause of all their torment and anger. The ugly custom of primogeniture is thus itself the dominant narrative imposed on Poynton's objects. It infects the relationships women have with one another in the text as they fight over objects, men and property. Mrs Gereth is therefore herself a desecrated object, callously cast aside by her husband. But she is also a literary object owned by James. He uses his authorial power to cast her as a callous tyrant rather than addressing the underlying motivations for her actions.

Fleda's place in the narrative is equally disquieting. Her subtle appreciation of 'thingness' only serves to heighten her sense of anxiety, her sense of powerlessness and her exclusion from a commodified world dominated by the exchange of property between men. Again, in the unfolding of Fleda's story there is an unresolved tension between James' recognition of women's lack of agency and his propensity to portray female characters in pejorative terms by entrapping them within his texts' narrative structures. Mona is coarse and greedy; Mrs Gereth is tyrannical and melodramatic. Fleda is more aesthetically conscious and possessed of greater intellectual refinement than these women. But James still presents these qualities as a weakness. "[D]ressed with an idea, though perhaps not much else", Fleda's subtle mind is too idealistic, lacking in practical awareness and to the detriment of her character (2). Fleda, James intimates, is not proud of her aesthetic sensibility; she is unable to cope with the demands it places on the consciousness. Rather, she views it as a cursed inheritance—a burden of which she tries to divest herself.

Yearning for prelapsarian ignorance Fleda wonders, "if it didn't work more for happiness not to have tasted, as she herself had done, of knowledge" (36). The knowledge of which she speaks is doubled. It is the recognition of the temporal, qualitative and multiplicitous intensities of things and the harm that can be inflicted upon them by people. But it is also the recognition that people can be possessed, coerced and debased: by other people and by powerful external forces. Such knowledge is deeply troubling to Fleda. She desires the solace of nothing over *no-thing*: of being absently ignorant rather than aware of absence. Because, though Fleda recognises that she is caught between "sides", neither the sole "agent" of Mrs Gereth or Owen, she is powerless to assert her own intentionality (48, 24). An indeterminate thing lacking the solidity that others possess, she is a corporeal embodiment of insubstantiality. Fleda thus seeks to become, like Owen, "delightfully dense": to acquire, in other words, blissful dim-wittedness and social mass (6). The prospect of being possessed by Owen provides for Fleda transformative potential. She is attracted to a life of economic, cultural and marital stability and the freedom from an ungrounded, flighty existence. Thus, when Owen clumsily reveals his feelings for her, Fleda admits a certain thrill in knowing "that she had become to him an object of desire" (71). Naturally, Fleda seeks to determine her future's trajectory by attaching it to Owen. Yet, after revealing to him her love, Fleda is left more desolate than ever: "'I haven't a rag of pride; I used to have, but it's gone. … [T]here isn't an inch of me that isn't his—!'"—a phrase that makes her as much a spoil to be fought over as any material object at Poynton (149).

Her first impulse is to seek solace with Mrs Gereth. But, like the objects of Poynton, Fleda is crushed under the "intense pressure" of Mrs Gereth's "load" (138):

> [It were] as if her companion, stone by stone, were piling some fatal mass upon her breast. She had the sense of being buried alive, smothered in the mere expansion of another will; and now there was but one gap left to the air (143-4).

Inheritance laws hurt Fleda too. Mrs Gereth, seeking an objective trace of her sense of self and a surrogate to replace her son and her treasures, inadvertently smothers the young girl. But instead of recognising the complex forces distorting the older lady's motivations (as we know, Fleda has also sought the objectification of her subjectivity), Fleda lashes out at Mrs Gereth: "'You simplify far too much. You always did and you always will. The tangle of life is much more intricate than you've ever, I think, felt it to be'" (155). Fleda has witnessed both the attraction and horror of being owned by someone or something and feels righteous in choosing a life of existential angst but independent pride. But she does not grant Mrs Gereth the same choice. Instead, "[h]er relation with her wonderful friend had … began to shape itself almost wholly on breaches and omissions. Something had dropped out altogether" (174). While Fleda thus begins to accept the constraints of her own "deeply divided" spirit—a spirit of transitive impact in a world defined by quantitative value—she is less ready to accept Mrs Gereth's (31).

In *Henry James and the Language of Experience* (1999), Colin Meissner suggests that Jamesian experience is "a fundamentally negative process through which one's subjectivity is constantly being breached and restructured anew".[87] Meissner disagrees with critics such as Mark Seltzer, who argue that James manipulates his characters' fates by reasserting the power of sociocultural hegemony over subjective freedom. The coercive force of capital construes relationships between people and things in terms of quantifiable, public transactions. But according to Meissner, these forces are fundamental to the ultimate liberation of James' characters who achieve their freedom through trial. James himself asked in 'The Art of Fiction' (1884), "[w]hat is character but the determination of incident? What is incident but the illustration of character?"[88] Meissner's thesis follows a similar logic. Processes of dialectical divestiture in James' works have transformative value. Being subject to "the economies of power which exert influence at culture's visible and invisible levels" has a forceful, often unpleasant impact on James' characters.[89] But, Meissner argues, from these negative experiences they are able to equip themselves with the tools needed to transcend these hegemonic forces. No longer bound by the past, James' characters are finally offered a revelatory moment offering "the ultimate escape ... into a world that is suddenly made clear and a self that is finally one's own."[90]

Meissner builds a solid case for his argument. However, I am less inclined to view the relationship between people, things and time in James' texts as ultimately redemptive. For Meissner, mere knowledge of wider power structures initiates a process of transformative liberation. But the narrative structure of James' texts consistently undermines this argument, *Spoils* being just one such example. Towards the end of the novel, Fleda revisits Poynton after a period of self-imposed exile. Upon arrival she is shocked to discover that the house and its things (now in the possession of

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[87] Colin Meissner, *Henry James and the Language of Experience* (Cambridge: Cambridge University Press: 1999), p. 187.
[88] Henry James, *The Art of Fiction* (Boston: Cupples and Hurd, 1884), p. 69.
[89] Ibid., p. 7.
[90] Ibid., pp. 10-11.

Owen and Mona) have been destroyed in a fire. But this is by no means the transformative fire of regeneration Meissner envisages. To the contrary, Fleda's slowly developing sense of self is shattered anew: "she became limp and weak again; she felt herself give everything up" (184). Her last spoken words, and indeed the final lines of the novel, are deeply unsettling: "'I'll go back.'" Exactly what or whom Fleda will go back to is unclear. What it does suggest is her entrapment within a repetitive cycle that will revisit upon her the experiences previously encountered over the course of the text. Certainly, it is not a closing remark that implies existential escape, as any restitution of the divided self will necessarily be re-fragmented. Instead, it is a reassertion of the past's power over Fleda. Her future is uncertain but what we do know is that it will involve going back, treading over the same ground she has trodden before. Thus, while Fleda comes to terms with her own conflicted nature, James does not allow her to achieve freedom. Her subjectivity remains *his* property, an object destined to "go back" and repeat the past.

If the ending of *Spoils* suggests a return to origins through the thematic and structural repetition of 'going back', then these unsettling implications are only fully realised in *The Turn of the Screw*. In this text, the possession of people and objects is profoundly disturbing. Relationships are construed in terms of the application of unequal force and normal circuits of communication are replaced by the transmission and conduction of charged energy. Matter, moreover, is rendered ontologically indeterminate as ghostly things interpose themselves upon stable reality. And adding to the novella's unsettling content is a lingering sense of coercive manipulation pervading the text beyond narrative confines. While James' ghost story concerns a past liberated from the control of human subjects in the present—which is what Harrison wanted for the Parthenon marbles—it is a past whose deterritorialised duration destroys characters, narrative unity and textual cohesion. As the concluding section argues, *The Turn of the Screw* is both a haunted and haunting object.

5.4 (Re)turn of the screw

Whereas "gaps and scars" mark the objects and characters of Poynton, *The Turn of the Screw* is itself full of "teeming voids" that proliferate from the opening page.[91] An unnamed narrator recounts a gathering of friends sharing ghosts stories round a fire. One of the guests claims to know a particularly haunting tale of supernatural possession. The main story is unpacked both figuratively and literally, as the manuscript of the tale has to be fetched from a locked desk in London. Through the novella's prologue we learn that this manuscript is a written record of an event remembered by the governess at the centre of the story. Already, there are three gaps separating our reading of the story from its 'origin'—the actual events, the governess' written impressions and the reading of the tale at the party. The narrator and the other characters in this introductory frame are never encountered again. Instead the unnamed governess whose memories comprise the main story takes possession of the first-person narration.

Such narrative uncertainties pervade the text. Blind spots between chapters, contradictory time frames, the lack of a return to the introductory narrator and the governess's lapses of memory all contribute to a sense of textual indeterminacy. Spurred by these ambiguities, critical evaluations of the tale have tended to focus on whether the spectres that haunt the governess are 'real' or, as Freudian critics maintain, a result of her sexually frustrated imagination.[92] This question is irrelevant. In fact, the ontological indeterminacy of the ghosts and the story's blank spaces allow the novella to resist closure. The inability to fix a lasting interpretation onto the text, and the resulting paradox this suggests for my own reading, creates a haunted and haunting textual object. As I shall argue, by filling its absences with critical theories and

[91] T. J. Lustig, *Henry James and the Ghostly* (Cambridge University Press: 1994), p. 116.
[92] See, for instance, Edmund Wilson, 'The Ambiguity of Henry James', *Hound and Horn*, 7 (1934), 385–406.

conflicting readings, *Screw* evades the possession of critics, characters, readers, and to an extent, even James.

Blanks, lacunae and open-ended circuits pervade every part of the text, from its structure to its language. Flora practices her handwriting by copying "nice 'round O's'" onto a "blank sheet of paper" and later begins playing with a piece of wood which has in it "a little hole" (18, 44). The lake is a "gray pool" with a "blank, haunted edge" (98). The servants at Bly are described as having hollow expressions ("she looked blank"; "the maids and men looked blank"), with Mrs Grose, the illiterate housekeeper, repeatedly reacts to the governess vacantly: "her round eyes started and her mild mouth gaped" (17, 102, 36). And the governess' memory is often unstable and prone to information loss: "I forget what I was on the present occasion"; "I had no subsequent memory" (43, 111). Events and people, moreover, are suggested through their negation. Mrs Grose, enquiring whom the governess has seen lurking in the grounds, asks whether it was "'nobody about the place? Nobody from the village?'" "'Nobody—nobody'", replies the governess, later answering a similar question "with a negative headshake" (34, 105). Moreover, often immediately after the governess has encountered one of the "living detestable dangerous presence[s]", her ability to form coherent thoughts is impaired (61). James indicates these stutterings and failings of cognition, action and language through the use of disconnected dashes that leave sentences half unfinished. For example, "'appeal to him for me—"; "'[a]nd if she is there—'"; "'my pupils have never mentioned—'", and so on (75, 98, 55). By my count there are sixty-nine occurrences throughout the text where sentences are interrupted this way and left incomplete. They are not dispersed evenly but cluster in chapters immediately following hauntings (especially in Chapters 5, 14, 16 and 21), creating a sense of narrative uncertainty and suggesting the appearance of the ghosts disrupts the governess' cognitive faculties.

These are but a few examples of a text that repeatedly "plunge[s] into the hideous obscure" as the story becomes progressively filled with uncategorised horrors

(122). The young governess tries to secure meaning against this vertiginous, shifting landscape but her attempts to remain "remarkably firm" by "forming as to what I should see straight before me" fail in the presence of the "alien object[s]" (120, 44). Throughout the novella, the uncanny-ness of unidentified things is advanced through subtle puns on the word 'matter'. The term retains its dual meaning of 'significance, burden, or topic' alongside 'body, weight, or substance'. 'Grose', for example, brings to mind the term 'gross', implying notions of vulgarity and indelicacy alongside physical heft. Mrs Grose, the governess believes, is unburdened by the knowledge of the dark sexual energy and supernatural occurrences haunting Bly. She is grounded in a simple world regulated by the temporal rhythms of Bly's maintenance. Moreover, the governess speaks suggestively of "matter beyond his [the uncle's] promise" and later, of "matters that ... now came back to me" (11, 13). What constitutes the matter beyond the uncle's promise is left teasingly to our lurid imaginations, though James implies it concerns the governess' sexual fantasies about the unseen yet powerful man. But the governess' fixation on indeterminate matter joins epistemology—knowing, or 'the matter at hand'—with ontology—being, what stuff is. Uncertainty over how the governess comes to know the world and what the reality of that world is marks her as, like Fleda, sensitive to the imponderable mysteries others fail to observe. The one thing we do know is that the ghostly past will return to haunt her present and future as these "matters ... come back to me."

Accordingly, matter is nearly always described alongside terms that render it either unstable, unfathomable or out of grasp, suggesting that both things and knowledge of them remain elusive. The name Peter Quint, as Joel Fineman points out, "couples male and female genitals": 'Peter', or penis joins with 'Quint'—an early etymological variant of cunt.[93] For Fineman, the hermaphroditism of the name points towards Quint's possible bisexuality and abusive sexual past. Yet it also conjures an image of both excess and uncertainty, refusing to conform to a simple dichotomy of

[93] Joel Fineman, 'The Turn of the Shrew' in *Shakespeare and the Question of Theory*, eds. Geoffrey Hartmann and Patricia Parker (New York: Methuen, 1985), pp. 138-59 (p. 159).

male or female gender. Immediately after the governess has seen Peter Quint for the second time, an appearance where "[h]e was there or was not there," Mrs Grose exclaims: "What in the name of goodness is the matter—?" (31, 33). James allows, possibly invites this to be read as *what in the name of goodness is the [substance, object, thing]—?* The dash leaves the sentence uncompleted and further adds to the sense of tangible absence. It also leaves the question of "the matter" (both in the sense of 'what's wrong?' and 'what was the thing that you saw?') unresolved. Similarly, upon discovering the identity of Miss Jessel's ghost and revealing this knowledge to Mrs Grose, the governess remembers: "there were in the matter I had put before her depths and possibilities that I lacked the resolution to sound" (51). Again, the "matter" here should be read in both an ontological and epistemological sense as the depth of possibilities as to what constitutes the ghostly disrupts fixed conceptions of the natural. As her rational worldview crumbles with the emergence of the haunted past, the governess' thoughts become possessed by something other than her own subjectivity.

The uncanny matter of the ghosts thus defies cognitive and narrative closure by refusing to be confirmed as objectively real, subjectively constructed, or a combination of both. This, in spite of the governess' consistent attempts to "settle the matter" by imposing order onto the situation (72). Throughout, the tangible absence/intangible presence coupling is advanced through the interplay between "something" and "nothing", the terms appearing a total of fifty-three and seventy-eight times respectively. Ghostly matter thus appears in sight but defies cognitive and sensory possession. Even the guest telling the story in the prologue is "at a loss how to qualify it"; "[i]t's beyond everything. Nothing at all that I know touches it'" (4).

Again, the implication is literal as well as figurative: both nothing and no thing can touch this alien substance. And yet, 'it' can reach from the past and affect the spatiotemporal environment of the governess. The circuits linking things, objects and subjects in *Screw* are always unequal—there is always a component that exerts a greater force than it receives in return. Reactions are not equal and opposite. The proliferation of networks structured around dominant and submissive power relations is, I contend, intentional. In fact, comparing the two editions of the text—the novella form I am using here and the serialised version originally published in *Collier's Weekly* in 1897—reveals a crucial change made between editions. The revised edition places greater emphasises on the violent power transmitted between characters and things. But it also draws greater attention to the governess' own position as a coercive, possessive and domineering force in the text.

In both versions the governess relates how, "in an image richly material," she sees herself as "a screen" standing between the spirits and the children: "[t]he more I saw the less they would" (42). In the serialised version originally published in *Collier's*, she continues:

> I began to watch them [the children] in a stifled suspense, a disguised excitement that might well, had it continued too long, have turned to something like madness. What saved me, as I now see, was that it turned to something else altogether.[94]

An intensive sense of movement plays across these lines, reminiscent of Bergson's conception of the qualitative multiplicity of emotional change: stifled suspense giving way to disguised excitement, disguised excitement melding into something like madness, this, transitioning yet again into "something else altogether." And holding these terms in place are the repeated past participles 'turned'. They hark back to the novella's title yet concurrently suggest the continual evolution of the present into the past and the governess' past into our future. Time travels through these lines in a way that is both tangible and elusive. Yet, in typical Jamesian style, the sentences are also disquieting, predicated on a possessive relationship between the watching governess and the watched children. In the revised edition the extract is almost identical except

[94] Henry James, 'The Turn of the Screw', in *The Two Magics* (London: Macmillan Company, 1898), p. 67. (This version of the text is identical to the serialised edition published in *Collier's Weekly*).

for two small changes. "[D]isguised excitement" is replaced by "disguised tension" while "something else altogether" changes to "another matter altogether" (43).

Both alterations are telling because they modify the sense of force and the meaning of matter. While "excitement" seems correlated to the governess' mental state and is localised to her, "tension" is indicative of *strain* and as such, exists as a modifying relation between two things. In a physical system, tension is the force exerted along, for example, the length of a wire that pulls upon objects attached at opposing ends. It stretches something tight. Likewise, emotional 'tension' is a consequence of being affected by something—of being put under strain. Tension in this context removes the action of the sentence from the governess and posits it as a correlation between either: her *and* the unnatural matter, her and the children, or the children and the spirits. The coupling itself is unclear and thus can be interpreted in a variety of ways. It creates multiple dynamic circuits where the exertion of force is disguised. Tension is itself not a force. However, tension exerts a force experienced by objects at the point of attachment and must result either in the equal distribution of force or its release. "Madness", in this sense, changes too. The noun is dispossessed from the sole ownership of the governess, as it is no longer predicated on her "excitement" but the wider tensile forces. Madness instead becomes a condition of both the governess' mental state *and* her spatiotemporal surroundings.

The second change between editions ("something else altogether" to "another matter altogether") once again shifts the subject of the sentence. Initially it is the governess' "excitement" which turns. But in the revised edition, the "matter" that turns can be read as both the governess' subjective experience and the supernatural objectiles of Quint and Miss Jessel. Disturbingly, what "saves" the governess is the steady acceptance that what she has experienced is indeed "another matter altogether" (128). "Something else" is certainly suggestive; but "another matter" confers a sense of indeterminacy to the sentence as it is pulled taut under the physical strain of 'tension'. When the governess tries to quantify the ghostly apparitions, to make them fit within a sensible epistemological framework, she is driven to madness. It is only by convincing herself that these ghosts really are of an unquantifiable, intensive and unnatural time and place, that the governess is able to accept the dreadful events that transpire. It is worth remembering that "another matter", whilst saving the governess, destroys the children. Convinced of the ghosts' reality, her attempt to exorcise their demonic power by putting their pasts to rest, results in Miles' death. Both changes, though subtle, shift the balance of power, creating even greater uncertainty over who has the truly destructive possessive force—the ghosts, or the governess.

Changes to the text further imply the lack of an original—the absence of a definitive ur-text from which stable meaning can be drawn. The text-as-object is itself "another matter," shifting between versions and refusing to settle. Ghostliness thus structurally inheres in the temporal dynamics of the novella as each text, similar yet different in their publication rhythms, appearance and language, haunts the other.[95] The notion of an original object therefore becomes inseparable from its strange fluctuations through time as the past returns as a differential repetition. Likewise, each appearance of the ghosts disrupts the linear succession of normal time, either emerging energetically "like the spring of a beast" or stopping time altogether (23). The position in time and space of the 'other matter' thus correlates to its power to exert force over the "extent and mass" of Bly and its inhabitants (14). Subsequently, as the narrative progresses the implied potential energy of the spectres increases too. As the governess explains to Mrs Grose: "'[t]hey're seen only ... in strange places and on high places, the top of towers, the roof of houses, the further edge of pools" (74). The governess' first meeting with Quint is accordingly related through a difference of position, as she sees him "high up, beyond the lawn and at the very top of the tower" (24). In these encounters, Quint's ability to exert force is greater than the governess'. Describing how "the sounds of evening dropped" as, accompanied by a change in natural order "the friendly hour lost ... all its voice" the governess experiences Quint's superior energy in

95 Each instalment published in *Collier's* was accompanied by a distinctly un-Jamesian masthead illustration, all drawn (with the exception of one) by American painter John La Farge.

terms of her own dispossessed bodily agency: "this visitant … seemed to fix me, from his position" (26).

Later in the narrative, Mrs Grose describes Quint as he existed in life: "[he] was so clever—he was so deep" (41). The governess is quick to respond with a question that belies her recognition of his energetic power: "[y]ou weren't afraid of anything else? Not of his *effect*—? [emphasis mine]." Again, the broken sentence hints that in both life and death, Quint had and still has a great deal of power. Alive he was in charge of the house and terrorised its inhabitants through his debauched behaviour. Dead, his supernatural energy disrupts the governess' cognitive cohesion as her language once again falters. Yet the dash inviting connective completion also implies that for this energy to be transmitted between material and supernatural realms, a conductive circuit has to be closed. As we have seen, James locates his description of alien objects and supernatural power in the language of tensile and potential energy. But the predominant energetic discourse James employs throughout the text is the electrical.

Ellen Wayland-Smith argues that James' *The Ambassadors* tells its "story through the medium of a particular receiving or 'recording' consciousness [that] reflects the techno-physiological framework by which his [James'] contemporaries theorized the functioning of human sense perception."[96] For Wayland-Smith, James' characters struggle to locate and recalibrate subjectivity in a world undergoing rapid and widespread changes to modes of communication. At the same time, however, late nineteenth-century physiological discourses used "analogical communication technologies, like the telegraph and the telephone, as theoretical models for the functioning of the human nervous system."[97] James construes consciousness in similar terms. The extent to which *The Ambassadors*' characters are able to communicate with "the external world" is contingent on the "availability and acuity of their receiving

[96] Ellen Wayland-Smith, '"Conductors and Revealers": Henry James' Electric Messengers in *The Ambassadors*', *The Henry James Review*, 32:2 (2011), 118-39 (p. 118).
[97] Ibid., p. 119.

equipment".[98] The same impulse informs the appropriation of electrical concepts in *Screw*. However the techno-physiological circuits of James' ghost story function as more than analogies for divided consciousness. They are also used to explicate the shifting balance of power between people and things and become part of the text's own conduction of and resistance to possessive energy.

Each new 'encounter' with Quint and Miss Jessel has on the governess a convulsive affect. Of the first haunting, she writes: "[w]hat *arrested* me on the spot—and with a *shock* much greater than any vision had allowed for—was the sense that my imagination had, in a *flash*, turned real [emphasis mine]" (24). Merely recalling the memory of this event "produce[s]" another "sharp ... shock." Later, the appearance of Miss Jessel inside the house proves to be the governess' "sharpest shock" yet (79). And, again cumulating in intensity the "flash" of yet another sighting produces in the governess a "shock" that sinks "deeper than I knew" (89). Each return of the past in the form of Quint or Miss Jessel thus induces a 'current' in the governess—that is, she is convulsively shocked by the past's entry into her *current, present situation*. The ghosts have a particularly discombobulating effect on the governess. The partially disconnected dashes of her sentences immediately following these shocks suggest the failure of ordinary neural networks to quantify the "alien objects". Indeed, each spectral appearance demands the readjustment of the governess' epistemological and ontological parameters.

But these semi-connected dashes also imply a desire for communicative closure. In one sense, this is partially achieved as other characters, particularly Mrs Grose, interject and complete the governess' thoughts: "'That she suffers the torments—!' ... she [Mrs Grose] filled out my picture ... 'Do you mean," she faltered, '—of the lost?'" (92). It is too far-fetched to suggest the preponderance of dashes and 'dots' (or blanks, little round o's and holes) directly invoke Morse code. Nonetheless, these symbols, incomplete yet also possessing connective and codified potential, are suggestive of the

[98] Ibid., p. 120.

desire to create closed communicative circuits. Indeed, for the governess, they offer the potential of tangible certainties—of an objective ontological dichotomy comprised of simple yes/no, real/unreal statements. Indeed, in the search for definitive epistemological and ontological stability, the governess begins actively to seek connection not only with other people but the spirits too. In spite of her claims to "resistance," the governess feels "obliged to reinvestigate" as "constant fresh discoveries" confirm her sanity: "I was justified; … I was neither cruel nor mad" (51, 33, 36, 103). In fact, connecting with the apparitions becomes for the governess such an "obsession" that she is not "deterred" by the knowledge her actions "might prove greater than the injury to be averted" (74). Both she and, she suspects, the children, are conductors of supernatural power. Their lack of "resistance" allows it to enter into the physical world through a closed circuit.

However, the various analogical manifestations of energy—electrical, potential and tensile—are used to frame more than simply the communication of power between natural subjects and supernatural objects. In fact, the text is littered with energetic terms that express the possessive and oppressive application of unequal force among people. Both the governess and Mrs Grose exert pressure upon each other: "she had joined me, under pressure"; "the person to whose pressure I had yielded"; "she had told me … under pressure, a great deal" (69, 23, 53). But it is the circuits of power created between the governess, Miles and Flora that are particularly noteworthy. Flora is the governess' "little conductress"—the conductor being the object or material through which electrical charge flows (15). Indeed, in the opening chapters, Flora is the recipient of the governess' possessive force: "little Flora had conducted me" (24). Moreover, the governess refers eight times to the children as "my [little] charges." Alongside the common notion of stewardship, the phrase also implies the capacity for the children to receive and/or transmit a force when brought into contact with other things. Initially, the "attraction of my small charges", recalls the governess, "was a constant joy" (23). Later, however, "the obedience of my little charges" is a source of suspicion: "[w]hy did they never resent my inexorable, my perpetual society? ... I had all but pinned the boy to my shawl" (81).

Who or what is in charge of the children, or whether the children are in fact themselves 'in charge', becomes a pressing matter. Chastising Mrs Grose for her apparent past negligence, the governess exclaims, "'little precious lives. They were in your charge.'" Mrs Grose replies, "'[n]o, they were not in mine!'", suggesting of course that some *other* person or persons were in charge of them (41). Indeed, as the hauntings increase and the governess uncovers the suggestively lurid relations between the children and Quint and Miss Jessel, the balance of power shifts. The ghosts initially have power over the governess, who in turn, has possession of her "little charges". But as the governess discovers Quint used to be "[i]n charge" of the house in the past, his power in the present also increases. It appears to the governess that the spirits have possessed the children or that they are together conspiring against her. And the governess herself is unable to resist the urge to connect with this supernatural energy. Her yearning for completion, sanity and communicative closure is in charge of her.

In the abundant manifestations of Jamesian energy—electrical, potential, tensile, personal and supernatural—the power dynamics of possession never stabilise. The past's phantasmagoric energy surges from alien beings to haunt subjects in the present. But as we have seen, circuits of power between people in the text are equally unsettling, characterised by the exertion, transmission and conduction of coercive force. *Screw* as a textual object also becomes inseparable from the power struggles playing across its pages. Shoshana Felman argues that attempts by readers and critics to impose meaning onto the text are necessarily fraught. She suggests that James reasserts the uncanny power of the text to defy interpretation the moment its readers proclaim they themselves cannot be duped by its indeterminacy. "In precisely trying to *unify* the meaning of the text and to proclaim it as unambiguous," she writes, "critics only mark more forcefully its constitutive *division* and duplicity [emphasis original]".[99] James himself writes in the preface to *Screw* that the critic will take the mere "adumbration" of evil, and fill the blank spaces with "his own imagination": a process that colludes in the text's deconstruction and restitution.[100] As the reader tries to fill the thematic and structural voids with coherent meaning, the text's narrative blanks, unfinished sentences and inconclusive events undermine attempts to contain it. For Felman, the simultaneous lack and abundance of meaning—the text's intangible presences and tangible absences—themselves constitute "the very *meaning* of *The Turn of the Screw* [emphasis original]."[101] Hence, Felman concludes, James retains ultimate control over the text. Like the absent uncle (and the "in charge" Quint), he remains a separate yet authoritative force.

However, the text's structural turns, its continually reorienting narrative and the oscillation between authorial control and authorial release, are more ambivalent than Felman recognises. In fact, the novella is simultaneously possessive and possessed. Each reading of *Screw*—including Felman's and my own—constitutes another 'turn' whereby the pastness of the text's 'meaning' is rewritten and incorporated into its renewed critical form. As the layering of interpretation accumulates, any suggestion of original signification is deconstructed as the copy transforms into its own origin. The plethora of half-finished sentences left open with the connective "—" combines with gaps in the text and the uncertainty of its 'matter' in asking to be fixed, stabilised and settled. Like the governess, the reader responds to nothingness by filling it with something: "my companion did turn, but the inquiry she launched was a silent one, the effect of which was to make me more explicit" (74). For a while, a circuit connecting reader and text is created but the balance of power—who has the greater possession over meaning—shifts back and forth. It is a circuit that can never be fully closed. Indeed, the conflicting critical studies of the novella, the on-going

[99] Shoshana Felman, 'Turning the Screw of Interpretation', *Yale French Studies*, 55 (1977), 94–207 (p. 114).
[100] Henry James, Preface to *The Turn of the Screw*, pp. 135–36.
[101] Felman, 'Turning', p. 144.

disputes over the reality of Quint and Jessel, the unreliableness of the governess' narration all confirm that nearly every aspect of *Screw* is impossible to ground. Absences, blanks and gaps—areas in which the *lack* of meaning is abundant—function similarly to the spaces *in between* fossils in the evolutionary museum: paradoxically, they produce intangible, deconstructive excess. The narrative never fully coheres as the text as object evades possession—by James the author and its readers. As the very opening lines of the tale read: "The story had *held us* [emphasis mine]" (6).

And yet, while the text has an uncanny possession over the determination of its own meaning (or lack thereof) independent of its author and readers, Felman is also right. At the same time as being a textual object capable of possession, it is also capable of being possessed. In my interpretation over these pages, I have 'turned' the novella into a critical object, whose 'meaning' and function I have described in detail. And yet, because of the indeterminacy of James' text and its excessive aporia, (re)reading the tale will inevitably reveal evidence that counters my interpretation. This oscillation between critical possession and dispossession is, I maintain, practically unique to *Screw*.[102] Because of its very ability to create meaning with autonomy alongside any temporary critical ownership, James, paradoxically, retains an incredibly forceful hold over his novella. In creating a brilliant textual object that will continue to be dissected, analysed and poured over by readers and critics, James reasserts the ultimate authorial control. The dynamic interplay between lack and excess; shifts in the balance of power; the repetition of past textual meaning twisted into new interpretative discourses—these are all created by and belong to James. *The Turn of the Screw* is the expression of a writer in total dominance over his subject and object matter. As soon as the tale ends with Miles', and by extension its own, "little heart, dispossessed", the text circles back to its opening page to repeat the past: to once again, 'hold' *and* be "held" (133).

[102] The only other text I have encountered with such extreme possessive and dispossessive tendencies is Mark Z. Danielewski's postmodern horror *House of Leaves* (2000).

5.5 Conclusion: haunted objects / objectile hauntings

If Harrison's claim that human actions in the present can desecrate the past has been a thread running through this chapter, then James' texts exploring, even embodying the possessive circuits of power between people and things has also shown the reversibility of this statement. Throughout, we have seen humans and nonhumans possess each other, subjects becoming objectified and objects being used to create, locate and store subjectivity. These relations, often coercive and violent, have inflicted wounds on people, things and time. Harrison's article in *Nineteenth Century* was convinced that the Parthenon marbles had been mutilated by imperial violence, their spatial form separated from their objectile unfolding through cultural time. Imbibing this anti-imperialist imperative in the structure of his text, Harrison creates an article not simply *about* the stones. His article also resonates *with* them, cohering into a textual memorial to desecration itself. This is achieved through the *failure* of his language to connect fully with the stones—its inability to convey qualities that cannot be put into words. Contrary to his contemporaries' characterisation of his positivism as reductionist materialism, Harrison's beliefs were ethically charged. He was acutely aware that the past was not homogenous and objective and that humans acting in the present had a duty of care to its preservation.

In contrast, the evolutionary showmen, such as Pitt Rivers, failed in their attempts to construct a visible narrative of time through the arrangement of fossils. Although their labelled, regulated and ordered specimens attested to great advances in public curation strategies, the spaces between these objects resisted quantification. These gaps pointed to a pure evolutionary duration out of grasp, which subverted imposed ideologies of progress. Public and private collections of objects were for James spaces of contested power. Like Lord Elgin and Pitt Rivers, James characterises Mrs Gereth as an imperial collector, amassing objects and things to ground her dispossessed selfhood. However, in her distinctly Victorian quest to embed subjectivity within the material, she stifles other pasts connected to the objects. Fleda, aware of the "gaps and scars" caused by Mrs Gereth's actions, is herself positioned as an indeterminate thing, whose own sense of self-possession is threatened by the coercive actions of others. Yet in eliding the patriarchal forces of primogeniture and construing women as partially to blame for their own dispossession, James' drama does not allow its characters the chance for existential restitution.

Power—electrical, tensile, potential, personal and supernatural—courses through *The Turn of the Screw*. Who is "in charge", who has the greatest possessive effect, is a question that is in constant turmoil. Whether or not Quint and Miss Jessel are 'real' is irrelevant. Either way, they burst from the past into the present to take possession of the governess' mind and body. Her encounters with these "alien objects" are shocking—and yet she also exerts pressure on others, forcing them to reveal information and collude in her increasingly obsessive actions. Continually interrupting and reforming these circuits of power are slippages of meaning, narrative blanks, distorted memories and breaks in language. In leaving the horror of the text undefined and inviting the reader to complete its open-ended connections—to use the text, that is, as a conductor for their own critical powers—such spaces are filled with interpretative meaning. Yet these theories fail to stabilise. They are (including this very reading) undermined by the text's inherent contradictions and structural gaps. Instead, *Screw* creates a surplus of dark, energetic meaning as the past (re)appears as a complex repetition, simultaneously owned and not owned. Oscillating between possession and dispossession, being "held" by the reader and author only for the text to reverse this construction to itself be "in charge", *Screw* is both a haunted *and* haunting object. The moment its past is rewritten by renewed critical turns, the text transitions back through a point of inflection to return to James' authorial control. Paradoxically, it is in being able to semi-autonomously power its own meaning that the ghost story reaffirms itself as a brilliant, intricate object, created by a fastidious, obsessive and manipulative author.

Although they frame the possessive relationships between people, intensive objectiles and time in different ways, Harrison's article and James' texts are united by their fundamentally unsettling nature. None of them are able to find a true equilibrium between the human and non-human. There always remains an exertion of force—a circuit of relations predicated on inequality where either subjective authority supresses 'thingness', or autonomous, wayward matter disrupts stable notions of the self. Possession is an enterprise defined by ownership and absence. It constitutes both an arrival and a deferral: something is acquired but it is potentially spliced from temporal contextualisation. James once suggested that it is only in recognising the innate elusiveness of things, by allowing all their "distances" and "mysteries" to breathe with indescribable intensities, that we might be able truly to encounter a "palpable, imaginable, visitable past".[103] The past that surfaces from these haunted texts is all of these things. But it is also mutilated, desecrated, possessive and possessed. Dreadful and portentous, what emerges out of the "deeper depths" of this disjointed past is, as the governess writes, an "ebbing actual … extraordinarily sweet sadness."[104] By the turn of the century, the ontological and epistemological destabilisation encountered by Victorians over the past fifty years had not been resolved. Intensive matter—whether the pressure and temperature differentials of thermodynamic systems, the mindless organic world of nonhuman desire or the strange incorporeality of material things—had permanently changed thought.

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103 Henry James, Preface to *The Aspern Papers and Other Stories* (Oxford: Oxford University Press, 1983), p. xxxi.
104 James, *Screw*, p. 118.

EPILOGUE

The onset of a new worldview

Two years after James explored the uncanny power of ghostly things in *The Turn of the Screw*, physicist Max Planck was grappling with the spectral energy of another mysterious object: the 'black body'. An ominous name for what initially seemed to be an innocuous problem, the German physicist Gustav Kirchhoff first proposed this object in late 1859. "[B]odies", he wrote, "can be imagined which ... completely absorb all incident rays, and neither reflect nor transmit any. I shall call such bodies *perfectly black* [emphasis original]".[1] Kirchhoff's black bodies were introduced in order to simplify an unresolved quandary. Victorian physicists had realised that the spectral energy emitted by an object was proportional to its temperature. A flame glowing red was not as hot as one glowing blue. In thermal equilibrium, however, Kirchhoff's black bodies emitted and absorbed an equal amount of radiation. This should have helped physicists come up with a working explanation. But over forty years later the problem still stumped them.[2]

In December 1900 Planck, through a combination of intuitive guesswork and experimental research, came up with an astounding solution. He suggested that black bodies could not absorb or emit energy continuously (like the water flowing out of a tap) but only in discrete packets, or 'quanta'. This idea was unbelievably strange; it conflicted with just about every principle of nineteenth-century physics. At the smallest level of reality, uncertainty and indeterminism reigned. A particle could be in two

[1] Gustav Kirchhoff, 'On the Relation between the Radiating and Absorbing Powers of different Bodies for Light and Heat', *Philosophical Magazine*, XX (1860), 1-36 (p. 2).
[2] Yuval Ne'eman and Yoram Kirsh, *The Particle Hunters* (Cambridge: Cambridge University Press, 1996), pp. 34-35.

places at once; electrons could seemingly pop into existence *ex nihilo*; and light behaved as both a particle and a wave *at the same time*. Five years later in 1905, the notion of energy quanta led Albert Einstein to propose the theory of *special relativity*, which described how objects moving at a constant speed in different inertial frames of reference affected time. The closer matter travelled to the speed of light, the slower time flowed. A decade later, Einstein shocked the world with his theory of *general relativity*, once again turning established scientific principles on their heads. As objects moved through curved spacetime their gravitational mass distorted the fabric of reality. Neither matter, time nor space were absolute.

These ideas complicated what were already absurd material ontologies. Writing in 1906, William James described the disruptive effect the "enormously rapid multiplication theories" had on epistemological assuredness:

> 'God geometrizes,' it used to be said; and it was believed that Euclid's elements literally reproduced his geometrizing. There is an eternal and unchangeable 'reason' ... So also of the 'laws of nature,' physical and chemical, so of natural history classifications—all were supposed to be exact and exclusive duplicates of prehumen archetypes buried in the structure of things ... Up to about 1850 almost everyone believed that the sciences expressed truths that were exact copies of a definite code of non-human realities. But the enormously rapid multiplication of theories in these latter days has well-nigh upset the notion of any one of them being a more literally objective kind of thing than another. There are so many geometries, so many logics, so many physical and chemical hypotheses, so many classifications, each one of them good for so much and yet not good for everything, that the notion that even the truest formula may be a human device and not a literal transcript has dawned upon us.[3]

In this passage, James compresses a huge amount of historical, cultural and scientific change into a single paragraph. Nonetheless, positioned on the threshold between intensive materialism and the onset of a new relativistic and quantum view of reality, James articulates the seemingly permanent state of epistemological upheaval engendered by these ideas.

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[3] William James, *The Meaning of Truth* (Cambridge, MA: Harvard University Press, 1975), p. 40.

Taking, as this thesis has, 1850 as the turning point at which the relationship between people and matter would enter into a state of perpetual flux, James describes a world on the cusp of modernity. Quantum and relativistic notions of matter impacted more than just scientific thought: they seeped into the collective cultural consciousness to disrupt and combine with art, literature and philosophy. The new material world of the early twentieth century was explored in Cubism's fractured objects viewed from multiple angles on two-dimensional surfaces and Futurism's artistic embodiment of dynamic nationalism, technological innovation and speed. Indeed, as Arthur J. Miller argues, "astounding developments in science, mathematics and technology contributed to the very definition of 'avant-garde.'"[4]

The onset of this worldview has been framed as a "paradigm … shift from classical physics to quantum mechanics".[5] However, there is a problem with this construction. The Oxford English Dictionary defines the 'classical' era of science as the "physics and mechanics … established before the introduction of relativity and quantum theory and … based on Newtonian principles."[6] Yet as this thesis has argued, nineteenth-century ontologies of matter, interweaving science, literature, the imagination, bodies and nonhuman forces, were resolutely non-Newtonian. Rather, they were *intensive*. Nineteenth-century writers and thinkers did not simply prepare the intellectual atmosphere for the material revolutions of the early twentieth century. In discovering and bringing into existence ideas that often seemed utterly absurd, they inadvertently contributed to these theories too.

It is difficult to trace all the myriad turns and contradictions that helped shape the Victorian turn to intensive materialism. But the texts discussed across these pages, in spite of their many differences, are all united by their non-empirical, speculative and imaginative responses to material heterogeneity. This thesis has argued that scientists,

[4] Arthur J. Miller, *Einstein, Picasso: Space, Time and the Beauty that Causes Havoc* (New York: Basic Books, 2001), p. 2.
[5] Man Cheung Chung and Michael E. Hyland, *History and Philosophy of Psychology* (Chichester: John Wiley & Sons, 2012), p. 87.
[6] OED online, http://www.oed.com/view/Entry/33881?redirectedFrom=classical#eid [accessed August 2015].

in their dissection of existing ideas and creation of new theories, used analogical, poetic and metaphorical constructs. Similarly, non-scientific authors appropriated concepts such as entropy, evolution and electromagnetism and transformed them into literary fictions. But Victorians—regardless of profession and personal belief—began to think in bodily as well as mental terms and regard language as a semi-autonomous open system. In claiming that texts are partially produced from nonhuman forces, this thesis has argued they did not simply reflect an intensive materialist worldview but were essential to its construction. Recent critical studies of nineteenth-century materialism also resist the tendency to focus on empiricism—a growing body of work to which my research contributes. Yet there is still much fertile ground for others to explore that I hope this thesis has gestured towards.

For Tyndall, interacting with matter's innate mysterious power was the cornerstone of his embodied materialist ethics. "There is assuredly morality in the oxygen of the mountains," he claimed, "as there is … a higher power than mere brute force … latent in the Alpine mutton."[7] Real materialism—shunning the brute matter of old—embraces the vibrant, unknown and sublimely fearsome heterogeneity of intensive matter, allowing it to shape and mould the individual. "We are recognising more and more", Tyndall wrote, "the influence of physical elements in the conduct of life, for when the blood flows in a purer current the heart is capable of a higher glow. Spirit and matter are interfused."[8] Pronouncements such as these make it all the more curious that Tyndall at times appeared hostile to nature and twisted scientific fact to produce sensationalist productivist fables. Similarly, Balfour Stewart and P. G. Tait saw in the ether a way to contort thermodynamic laws to fit an eschatological narrative. In their convoluted attempt to restore spiritual balance in the cosmos, they inadvertently created a text filled with fallacious reasoning and entropic tendencies.

Maxwell, however, pioneered a novel analogical approach to material problems. One of his greatest concerns was the reductive inadequacy of empirical epistemologies:

[7] Tyndall, *Hours*, p. 155.
[8] Ibid., pp. 155-56.

he believed glimpsing matter and spirit's dynamism involved combining knowledge from different domains. Indeed, Maxwell explored questions of thermodynamic probability, free will and the transmission of information by conjoining science, language and the poetry of John Milton. Importing these inputs into analogical structures that behaved like modern day black boxes, he generated new physical and philosophical ideas negentropically. Likewise, Browning was concerned with how to represent in finite language the ideal immanent to, not distinct from, material reality. The experience of love and the disjunction felt in failing to converge with another's world crystallised this tension. His poetry pioneered a new realist style, which teetered on the threshold between matter and spirit. Moreover, in exploring the terrifying and multiplicitous power of nonhuman organic life, he anticipated nascent evolutionary ideas and their threat to the unified constitution of the self.

For James and Harrison, how to integrate what was still an unsettled past into the relentlessly onward present was a problem that had no easy resolution. Their texts showed that by the turn of the century the already indeterminate boundaries between subjects and objects, human and nonhumans had become even more precarious. Indeed, at these points of contact, power surged between things, people and even their own texts, to possess and debase. Unsettlingly, their writings were unable to find, or refused to allow for, the possibility of a restorative epiphany.

It was in intensive matter that these writers, scientists and poets discerned a certain "promise and potency" of life. Tyndall, contemplating in 1868 the sublime Alpine landscape, found his thoughts turning to "that nebulous haze which philosophers have regarded ... as the proximate source of all material things."[9]

> I tried to imagine it as the seat of those forces whose action was to issue in solar and stellar systems, and all that they involve. ... Did the thought which now ran back to it simply return to its primeval home? If so, had we not better recast our definitions of matter and force?[10]

[9] Ibid., p. 291.
[10] Ibid., pp. 291-92.

If, Tyndall continued, "life and thought be the very flower of both, any definition which omits life and thought must be inadequate, if not untrue."[11] This thesis has adopted Tyndall's supposition, offering new ways of thinking about nineteenth-century matter, bodies and minds. And yet, unable to trace all of the twisted fibres, the folds and broken stitches of this intensive materialist fabric, my work offers only a partial glimpse of its textures and hues. If we are to continue to engage with our world productively and ethically, if we are to witness the continued creation of new material worldviews, we must first accept our own conceptual failings. From the expressivity of organic life to the recumbent pleats of mountains, submicroscopic atomic vortices to the raging furnaces of stars, material reality is far stranger than we can ever imagine.

[11] Ibid., p. 292.

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